The Roles of Gesture in Piano Teaching and Learning

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Award date:
2015

Awarding institution:
Queen's University Belfast

Queen's University
Belfast

The Roles of Gesture in Piano Teaching and Learning

Thesis submitted to the School of Creative Arts for the degree of

Doctor of Philosophy (PhD)

September, 2014

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MA, BMus (Hons)

Abstract

The experience of engaging with music through listening, teaching and learning would be impossible without a bodily interface, through which movement and music can be physically produced, experienced and understood. Physical gestures form a central part of the communication established between the teacher-student dyad in the communication of symbolic and functional musical knowledge. Factors such as gesture types (forms and meanings) and their specific outcomes in the teaching and learning processes, have been consistently overlooked in the instrumental music pedagogical context. This thesis prioritises such undervalued topics, focusing its enquiry upon piano teachers' physical hand gestures used to communicate with students during the teaching process. Thus, it incorporates and bridges theoretical frameworks from disciplines including music-psychology, psycholinguistics, gesture studies, gesture-led educational research, imitation and observational motor-learning.

Three investigations were carried out. The first two combined qualitative and quantitative approaches – results of which were used in establishing the first known categorisation of piano teachers' gestures. Amongst the most intriguing findings were the relationship between teachers' didactic intent and the forms of gesture they employed, and 'gestural scaffolding' (when teachers adapted particular gestural communicative channels to suit specific student skill levels). In the third investigation an experimental setting was used to observe and evaluate the role of teaching gestures in one-to-one instrumental tuition. Here different gestural teaching and learning conditions yielded multiple levels of learning effectiveness, implying a need for empirical understanding and establishment of gestural performance as a concept that can be applied to enhance learning across specific pedagogical contexts. As well as building a case for future investigations in this research area, this thesis opens a

debate within studies of pedagogical practice in instrumental music teaching, whilst contributing more generally to discussions of how the body impacts upon music understanding.

Acknowledgements

There are a number of people whose help and support contributed in various ways to the completion of this thesis. I would like to express my gratitude to my supervisors, Franziska Schroeder and Matthew Rodger, who have been ever-present for me, providing discussions, meetings, insights, revisions of work and promptly answering my queries, even outside of working hours. As well as their expert guidance, I have also been lucky to enjoy the considerable freedom they have given me to find and establish my own research pathway. Their many questions have stimulated me to reflect deeply on my work and have contributed decisively to the direction taken by this research. I have felt honoured by their trust and encouragement which, especially at difficult times, motivated me to keep working to the best of my ability.

I am hugely grateful for the opportunity of undertaking this research granted by the Department of Employment and Learning, Northern Ireland (DELNI) who financed this research post through a PhD studentship administered by Queen's University Belfast (QUB). Many thanks at QUB also go to Heather McGregor and Rachel McGill from the Postgraduate Centre who (respectively) supervised and coached my journey in a nine-month leadership and management course, not to mention the many other doctoral colleagues who took part in this training. This course has placed the 'cherry on the cake' to my PhD journey providing insights into efficient planning, organisation, time management, continuous professional development and leadership skills. I am also grateful for the assistance of my proof-reader, Paul, who has helped me to improve the clarity of my writing.

At the Sonic Arts Research Centre I would like to thank Chris Corrigan and Craig Jackson for their technical assistance. Pearl Young and Marian Hanna also deserve thanks for their help with practical and administrative matters. And I extend thanks too to all my PhD colleagues for insightful discussions on the challenges and opportunities of doing a PhD. I also owe gratitude to Maarten Van Walstijn who developed a software programme using Matlab software for analysing audio data of the study reported in Chapter 6. This programme spared many hours of data analysis that would have been needed otherwise. I am also grateful for: the input of study participants, piano teachers, students and students' parents for their vital contributions in making this research possible; the independent annotators, Maria Hoy and Niall Kavanagh cooperation for the studies reported in Chapters 3 and 4; and Juliana Licinic van Walstijn and Anshuman Shinde for similar cooperation in the study reported by Chapter 6; Paul Bassett, who provided relevant insights into the statistical analysis of the studies reported in Chapters 3, 4 and 6; The input of the anonymous reviewers of articles completed in parallel to the work developed in this thesis was also vital in improving both my published work, and my thesis overall.

I pay very special acknowledgement to my first ever music teacher, Mario Coelho, who suggested to my parents that I initiate musical studies at the local conservatoire, when I was aged 12. This apparently simple suggestion has had tremendous repercussions on my life, as whole new journey of music discovery began – a journey which I still enthusiastically pursue. Another important acknowledgement needs to be given to two of my piano teachers who profoundly marked my pianistic development: Maria João Carreira and Tatiana Melikova. Maria João was my first piano teacher and remained so for five consecutive years. With her patience, kindness and friendliness she motivated me to continue, and in the process I have developed a deep-seeded intense passion towards music. Tatiana helped to bring my involvement with piano playing to a much deeper level, revolutionising my playing ability and instilling in me a life-long desire to teach piano. It was her teaching influence and inspirational music making that eventually culminated in the research questions posed for this research.

Thanks also to Juliana Licinic van Walstijn for her input in this work, through her advice, suggestions and patience in listening to me at all times, including in those days in which I wasn't as cheerful. Juliana's words provided encouragement that 'kept me going' by visualising the end line, the enjoyment of a much needed break after all the work is completed and the need of taking it 'step-by-step'. Many of these talks were accompanied by chocolate – but as a very good friend she realised that enough is enough and later also brought me a book on dieting.

I extend very special thanks to Anshuman, the best friend anyone would wish for and who I am fortunate to have. Despite the fact that neither music, gesture or research belong to his fields of work or interest, Anshuman has had many discussions on these topics with me, during days, nights, weekdays, weekends and even holidays. He helped me to get to grips with several software tools that were extremely helpful for data analysis, such as Elan Software, Kinovea and Matlab software. He cooked, cleaned and has cared for me in the good and worst ever situations, such as when I broke my right ankle just seven months before this thesis submission. I have absolutely no words that can describe how immensely thankful I am for all his attention, support and care. Thanks to my parents and siblings who often advised the importance of a balance between work and rest. And finally, but not least importantly, thanks goes to my children Zara and Umar – your presence and joy is the most precious gift in my life. Your hugs and smiles were and are the energising motor in which I find strength to keep going. I will never forget Umar's advice regarding how to write a PhD thesis quicker, as he felt I was taking long to complete it. Nor shall I forget the days in which he gave me a goodnight kiss, instead of waiting for me to do

so to him at his bed. And Zara's statement that she would only read one page of this work – the *last* page – certainly encouraged me to actually write that very last page.

Lilian Lima Simones

Queen's University, Belfast. September, 2014

Remark

The following publications resulted from the investigations carried out for the purposes of this thesis, by this author:

Simones, L. L., Rodger, M., & Schroeder, F. (2014). Communicating musical knowledge through gesture: piano teachers' gestural behaviours across different levels of student proficiency. *Psychology of Music*. Advance Online Publication. doi:10.1177/0305735614535830

Simones, L., Schroeder, F., & Rodger, M. (2013). Categorizations of physical gesture in piano teaching: a preliminary enquiry. *Psychology of Music*. Advance Online Publication. doi:10.1177/0305735613498918

Simones, L., Rodger, M., & Schroeder, F. (2014). Seeing how it sounds: observation, imitation and improved learning in piano playing. Submitted.

Some passages have been quoted verbatim from the above sources.

Contents

Abstract ii
Acknowledgements iv
Remark viii
Contents ix
List of tables xiii
List of figures xiv
Introduction 1
Chapter 1
Establishing a path for the journey 5
1.1 Realising the power of gestural communication through a musical educational experience 6
1.2 Grounding the rationale: gestures *seen* and *unseen* by music research literature 8
1.3 Setting the scene 13
1.3.1 A gesture definition for this thesis 14
1.3.2 Context 18
1.3.3 Research questions and brief methodological considerations 19
1.3.4 Influences from other disciplines 21
1.4 Thesis overview 25
Chapter 2
Gesture in piano teaching 29
2.1 Bringing gesture in piano teaching into focus 30
2.1.1 Social, communicative and embodied dimensions of piano teaching 32
2.2 Gesture research across different musical landscapes 41
2.2.1 Conducting 42
2.2.2. Music performance 45
2.2.3 Music education 49
2.2.4 Instrumental and vocal music education 52
2.3 Gesture in other landscapes 56
2.3.1 Understanding the integrated view 58

2.3.2 Gesture for speakers: thinking and communicating 61
2.3.3 Gesture for addressees 68
2.4 Summary and new directions in the piano teaching and learning landscape ... 72

Chapter 3

Categorisations of physical gestures in piano teaching 75
3.1 Categorisations of gesture in music performance 77
3.1.1 Understanding co-verbal gestures classifications..................................... 82
3.1.2 Parallels between gesture, music and speech 88
3.1.3 Seeking a context-dependent ground for gesture...................................... 91
3.2 Study - Categorisations of physical gesture in piano teaching: a preliminary enquiry.. 96
3.2.1 Methodology.. 98
3.2.2 Results.. 103
3.2.3 Discussion.. 110
3.2.4 Conclusion 116

Chapter 4

Teachers communicating music through gesture across student skill level.. 118
4.1 Teachers gesturing towards communicating musical knowledge musically.. 120
4.2 Communication of symbolic and functional musical knowledge 126
4.3 Gestural scaffolding processes 134
4.4 Study - Piano teachers' gestural behaviours across different levels of student proficiency.. 140
4.4.1 Methodology.. 140
4.4.2 Results.. 143
4.4.3 Discussion.. 148
4.4.4 Conclusion 152

Chapter 5

Gesture in piano learning.. 154
5.1 Gesture mediating piano learning... 155
5.1.1 The relationship between gesture, learning and musical meaning 161

5.1.2 The role of gesture in the generation of music mental representations ... 167
5.1.3 The role of gesture in fluency and expression 171
5.1.4 Mediation of goal-directed actions 175
5.2 Insights about the relationship between gesture and learning from other fields of knowledge 179
5.2.1 How gesture helps learning: proposed mechanisms 184
5.3 Summary and points of departure... 186

Chapter 6

Observing and imitating instrumental music teaching gestures 190
6.1 Learning through teacher's demonstrations 191
6.1.1 Learning through observation.. 196
6.1.2 Learning through imitation 200
6.1.3 Relationship between auditory and motor learning processes................. 206
6.2 Study - Seeing how it sounds: observation, imitation and learning in piano playing 211
6.2.1 Method 214
6.2.2 Results……...…………………………………………………………221
6.2.3 Discussion 228
6.2.4 Conclusion 234

Chapter 7

Conclusions and future directions 236
7.1 Empirical findings: answering the research questions and contextualisation.. 238
7.2. Implications, new research directions and limitations 247
7.3 Conclusive remarks 252

References.. 254

Appendix A
ABRSM minimum skill requirements for piano grades 1 to 8
in 2011-2014 period 308

Appendix B
Print screen of annotated file using Elan Software 309

Appendix C
Research ethics application for the investigations reported in Chapters 3 and 4..... 311

Appendix D
Participants' information and consent forms used for the investigations
reported in Chapters 3 and 4 319

Appendix E
Ethics application for the investigation reported in Chapter 6........ 323

Appendix F
Participants' information and consent forms used for the investigation
reported in Chapter 6........ 332

Appendix G
Researcher's monologue for the experimental study reported in Chapter 6........ 335

List of tables

3.1. Kendon's continuum as established by McNeill (2000). 84

3.3. Teaching behaviour categorisation in use for this study. 100

3.4. Gesture categorisation in use for this study.. 101

3.5. Cohen's Kappa inter-annotators agreement. 102

3.6. Cross-tabulation of behaviours versus gestures. 108

3.7. Cross-tabulation of behaviours versus teachers. 110

4.1. Poisson regression results on teachers' combined gesture occurrences. 144

4.2. Results of Poisson regression analysis on gesture occurrences individually performed per teacher.. 146

6.1. Participants' characteristics: gender, age range and average time of engagement in formal piano tuition per experimental condition. 215

6.2. Description of teaching and learning conditions used in the experiment..... 219

6.3. Retention and transfer tests timetable and task required per test 220

6.4. Post hoc comparisons of SIDR (Sound versus Inter-Onset Duration Ratio) and RWA (Rotation of Wrist Amplitude) across retention tests and teaching conditions. 224

6.5. Post-hoc comparisons of SIDR (Sound versus Inter-Onset Duration Ratio) and RWA (Rotation of Wrist Amplitude) with observed interactions with other variables... 228

List of figures

3.1. Gesture types used by the totality of teachers. 103

3.2. Gesture types individually used by the three teachers. 104

6.1. Description of the extension and flexion movements used to perform the Mimic gesture performed for this study. 216

6.2. SIDR (Sound versus Inter-Onset Duration Ratio) mean values overtime, per teaching condition, for all students (proficiency groups I and II combined). 222

6.3. RWA (Rotation of Wrist Amplitude) mean values overtime, per teaching condition, for all students (proficiency levels I and II combined). 223

6.4. Comparison of SIDR (Sound versus Inter-Onset Duration Ratio) for retention/ transfer student proficiency level groups I and II. 226

6.5. Comparison of RWA (Rotation of Wrist Amplitude) for retention/transfer student proficiency level groups I and II. 227

Introduction

> Hands are a principal component of the intersubjective signalling system
> by which human minds share their states and ambitions.
> (Trevarthen, Delafield-Butt & Shögler, 2011:19)

It is amazing *what* and *how much* humans can communicate simply by playing a musical instrument. Music making is a fully embodied activity performed and perceived through gestures (Leman, 2010): a multimodal phenomenon processed in a dynamic interplay between our senses, sensory organs and modalities[1] (Maes, Leman, Palmer & Wanderley, 2014), within which the human hands play an essential role. More specifically, the human hands are directly involved in the motor aspects of playing a musical instrument; they serve as an aid to understanding the conceptual and practical musical knowledge needed to perform and interpret musical material. Hand gestures are also an essential communicational element of the teaching and learning process. However, a plethora of issues relating to such teacher/student ges-

[1] i.e. Visual (sight), auditory (hearing), tactile (touch), olfactory, gustatory (taste, particularly in the case of wind instrumentalists), vestibular (related to the sense of physical balance and equilibrium) (see Jensenius, 2007).

tural interaction remain as wholly neglected, unwritten chapters of music research literature. Research into this area might stimulate answers to a range of questions, including: can educational practices and specific learning contexts play a decisive role in the way that performers use gestures during musical performances? If these gestures are learned, what is the significance of the environments in which they are attained? And, ultimately, can instrumental music teachers' gestures be optimised in order to promote better learning?

Given gesture's essential and integral status for music making, and the fact that music making is in itself rooted in educational and cultural practices, it follows that instrumental music teachers' gestures have an important role in the communication of symbolic and functional musical knowledge to students. This statement constitutes the central argument of this thesis, which focuses exclusively upon piano teaching and learning undergone in formal educational settings, on a one-to-one basis, and entirely in the western classic music tradition[2]. Empirical work to support the central argument consists of three studies using mixed qualitative and quantitative research methods, methods which are grounded upon a varied theoretical framework from domains such as music psychology, psycholinguistics, gesture studies, gesture-led educational research, imitation, observation and motor learning research.

For the purpose of this work, 'gesture' is used in the restricted sense of spontaneous hand and arm movements[3] occurring in the pedagogical process of music making that carry an intention (Gritten & King, 2011) and/or a perceived meaning (Hatten, 2006). This definition amalgamates several ideas around gesture definition,

[2] I would like to make clear that despite opting to research the above mentioned context, I consider all musical traditions around the world to be equally rich and in equal stance with the musical tradition in this study.

[3] Reasons for the conceptual decision of focusing solely on hand and arm movements for the work developed throughout this thesis are appointed in Section 1.3.1

such as the ones proposed by Kendon, 2004, Leman & Godoy, 2010 and McNeill, 1992[4], here used to account for the undoubtedly intentional and communicative context of teaching/learning to play a musical instrument. The focus of the investigation is specifically on teachers' gestures, which are classified from two perspectives: 1) spontaneous movements of the hands and arms that accompany speech that are not associated with a practical music making experience ('spontaneous *co-verbal gestures*', McNeill, 1992, 2005); and 2) spontaneous movements of the hands and arms specifically dedicated to music making, communicating symbolic and/or functional musical knowledge (entitled 'spontaneous co-*musical* gestures' (resultant from the first investigation carried out for the purposes of the present thesis and reported in Chapter 3). So, to clarify: spontaneous co-verbal gestures are considered in instances where people may be 'talking about music' or 'taking about something else', and spontaneous co-musical gestures for situations in which people are actively engaged in a practical experience of music making, that can in itself include spoken (verbal) language.

Over recent years there has been an increasing acknowledgement that if formal instrumental music instruction can promote children's musical socialisation (Adachi, 1994), then more attention should be given to improving and optimising teaching (Barrett, 2005; Byrne, 2005; North & Hargreaves, 2008; Young, 2005). Ultimately, such realisation instigated increased research in instrumental music teaching and learning, particularly over the last ten years[5]. However, considerations of how teachers teach in this pedagogical context need to apply equal attention to gestural communicational channels so as to enable studying outcomes of teaching prac-

[4] For more on the conceptualisation of this gesture definition see Section 1.3.1.

[5] For the latest update on research in the instrumental music teaching and learning context see *The Oxford handbook of music education*, (2012: 651-768), volume I , Edited by G. McPherson and G. Welch, Section dedicated to 'Instrumental music'.

tices on learning in relation to student skill levels. In doing just that, this thesis aims to provide a realistic picture of this context in which music production is intrinsically dependent upon gesture and body movements, as is the teaching process itself.

Chapter 1

Establishing a path for the journey

In this chapter, the essential ideas that shape this research journey are exposed and justified in light of relevant literature. I begin to unpack and explore this complex and layered research area through a personal anecdote, which taught me the power of gestural communication in instrumental music teaching and learning (Section 1.1). This is followed by an introductory consideration of gestures *seen* and *unseen* within music literature, which I use to assert the rationale and importance of this work (1.2). Subsequently, I outline the conceptual and practical boundaries of my research project through a detailed theorisation of the term 'gesture' in this thesis' research context, alongside a statement of the research questions and acknowledgement of influences from other disciplines (1.3). This chapter concludes with an overview of the work developed in subsequent chapters (1.4).

1.1 Realising the power of gestural communication through a musical educational experience

It is not an overstatement to say that music has changed my life in quite profound ways. The music experience which has influenced me most took place over the course of a series of one-to-one piano lessons when I was 15 years old, as a sixth-grade piano student. The moment that I met Tatiana (at the time, my new piano teacher) is deeply engraved in my memory. I looked at her, greeted her and asked: “English?”, she said: “No!”; “French?”, she said: “No!”; “Portuguese, Spanish?” again, she said no, while opening the classroom door and gesturing as she invited me to enter the room. At that specific moment an important dilemma called to mind, that if we didn’t share a common language, how could she teach me? And how could I learn? Interestingly, it took just a few minutes for those questions to dissipate: Tatiana’s facial expressions, gestures, Russian words (whose meanings I still do not understand) associated with the gestures and the Russian/Portuguese dictionary (occasionally used), was all that was required for us to communicate effectively.

Tatiana’s teaching methods involved the communication of practical and abstract information which she well managed to convey without recourse to specific verbal, linguistic instructions while utilising a range of strategies to achieve ‘embodiment’ of the musical content. Her teaching was in stark contrast to my previous experiences as a piano student: whilst previous teachers focused essentially upon musical notation (in terms of pitch and rhythm), Tatiana attended to embodying the engagement with musical material, and (by extension) to the linked physical and psychological experiences of music making. This approach (radical to me, at the time), was deeply inspiring. Tatiana was able to produce (what I and others would term) ‘magical’, ‘beautiful’ and ‘heartfelt’ music through an embodied practice, which she communicated to me mostly through gestures aimed at translating theory into practice. This is relevant to the current project because over the years I have developed a marked curiosity as to how, in the absence of a common verbal register, Tatiana and I could establish such rich musical communication. Relying almost wholly upon physical expression, my classroom experiences with Tatiana taught me powerful lessons in the profound communicative and pedagogical power of gesture.

While learning and training to become an effective piano teacher, I carried out reflexive analyses on this personal learning experience. The most relevant questions I found myself debating were: why don't all teachers place such emphasis upon musical embodiment? How can tutors like Tatiana accessibly communicate such complex information without a common verbal language? Could gestural communication actually be more effective for teaching and learning to play a musical instrument than verbal language? And, do certain people learn more easily through gestural channels than others? Or could gestural channels represent a 'universal' teaching and learning tool impacting upon students' specific learning outcomes? Inevitably raising more questions than answers, this experience led me to conclude that gestures are an integral and important element for teaching and learning in the instrumental music context. They are as vital for communication between teachers and students as they are essential for playing, teaching and learning the intended musical instrument. More specifically, and as this thesis will demonstrate, gestures are involved in the acquisition of practical knowledge in relation to the motor aspects of playing a musical instrument and in the communicational aspects required for learning how to communicate music.

Despite this importance, however, gesture is rarely afforded the pedagogical merit that it deserves in the teaching and learning process. Even in light of the recent critical interest in this area by the research community in the field of music performance, gesture remains mostly 'unseen' to research in this context. Such invisibility constitutes a major threat to the development of a much needed empirical pedagogy, required to consider gesture as a communicational and integral aspect of the musical gestural repertoire needed to embody the musical content.

1.2 Grounding the rationale: gestures *seen* and *unseen* by music research literature

Despite early work that would eventually contribute to the field that we now term 'gesture studies' (e.g., Efron, 1941/1972); Kendon, 1972, 1980; McNeill, 1979, 1981), it was not until the 1990s that gesture and body movement were considered by academic research in the field of music performance, through the seminal work of Jane Davidson (1993). In a study investigating the role of visual perception in conveying meaning and emotion in musical performance, Davidson found that the visual aspect of a musical performance has an important role in the expressive communication that occurs between the musician and the audience – conveying more expression than the sound of the music alone. The visual aspect included body movements analogous to the hand and face gestures that accompany and emphasise speech 'meaning' in day-to-day communication. These findings impelled further substantial research dedicated to solo music performance (e.g. Clarke & Davidson, 1998; Davidson, 1994, 1995, 2001, 2005, 2007; Davidson & Correia, 2002; Price & Winter, 1981; Wanderley & Vines, 2006), ensemble performance (Dahl & Friberg, 2007; Davidson & Good, 2002; Goebl & Palmer, 2009; Yarbrough, 1975), and gestures used by orchestra/choir conductors (Boyes Braem & Braem, 2000; Decker &

Kirk, 1988; Durrant, 1994; Poggi, 2007, 2011; Wöllner, 2008), which mostly focused on expert music performers.

Relevant findings from this strand of research include Delalande (1995) gesture types where each gesture type represents an expressive behaviour related to different body postures, affirming a correlation between gestures used for music performance and their emphasis of musical structure, which would be researched elsewhere (Chaffin & Logan, 2006; Davidson, 2006, 2007; Elsdon, 2006; Williamon & Davidson, 2002). Moreover, gesture studies in the context of singing (Clayton, 2005; Davidson, 2001, 2005; Rahaim, 2008) show that the singer's coordination and song narrative expression relies upon non-verbal codes similar to those used in speech (Clayton, 2005; Davidson, 2005).

Nonetheless, the wider academic recognition (over the past two decades) of the importance of gesture for music performance did not correspond to an acknowledgement of the impact that teaching and learning contexts can have on the resulting musical performance. Crucial aspects of this area have been overlooked, including: how body movements and gestures essential for performance are developed during the process of skill acquisition; the level of 'physicality' involved in teaching and learning to play a musical instrument; and the essential role of the teacher in the development of this embodied skill. The educational-psychology notion that "we become ourselves through others" (Vygotsky, 1966: 40) implies that musical biological predispositions towards musicality are shaped and developed through interactions with other people, groups, institutions and situations within a certain culture (see (McDonald, Hargreaves & Miell, 2002). This also highlights, however, that understanding processes of musical and identity development hinges upon clarifying the teacher's role in the mediation of musical knowledge. Although the above research calls did not cry out for the specific investigation of gestural elements, it is clear that gesture not only accompanies, but also augments and enhances sound, forming crucial connections between performer(s) and audience(s). The creation of musical meaning, musical sound and gestural communication are embedded in essential and complementary ways in the instrumental teaching context. So, how are gestures used in musical performance learned, and what is the significance of the environments in which they are attained?

Davidson (2005) highlights that some gestures used in vocal musical performance seemed to have been learned from teachers. This was evident in one of her studies focused on a musical performance by a jazz singer and a pop band combining rock with traditional Celtic folk music, where performers were observed using a variety of gesture type to communicate musically with audiences and co-performers. Such gestures and musical intentions are, as argued by Davidson (2005: 233) "embedded within a cultural framework…[and] might [have been] learned from a teacher (like the violin players using certain performance movements such as knee bending)". In addition, based on his investigation of gesture and voice in Hindustani music, Rahaim (2008) states that although singing students tend to gesture like their teachers, their gestural repertoire is nonetheless idiosyncratic. These researchers' view points indicate a growing awareness of the importance of understanding musical performance through the educational contexts that have spawned them. Given its close interplay with verbal content, it is not surprising that gestural elements were first explored by research associated with singing. This encouraging direction of research has, however, still to be extended to specific musical instruments, and their learning and teaching contexts. The absence of such considerations is clearly evidenced in recently published literature on psychology of performance where there is minimal reference to the physicality of music teaching and its vital contribution to musical meaning (e.g. Godoy & Leman, 2010; Gritten & King, 2011).

An important instance of this is evident in the *Oxford Handbook of Music Education* (2012) (edited by G. McPherson & G. Welch). This collection dedicates greater attention than before to teaching as a process, including an innovative chapter by Jane Davidson entitled 'The role of bodily movement in learning and performing music: applications for education' (see Davidson, 2012). In this instance, Davidson attempts to transpose findings from gestural research undergone in the field of musical performance to the wider educational and instrumental music teaching context. However, such an attempt overlooks the fact that the instrumental educational experience constitutes a musical performance in an interactive discursive experience, through which meaning is constructed and so, this context needs to be understood in itself and not through the eyes of research focused on performing to an audience. Secondly, besides lacking a contextual empirical basis, considerations and advice given to teachers and educators in the article (some examples below) are vague and cannot bring much improvement to our day-to-day teaching practice. Consider:

> …there are no definite answers about how these models [models that try to describe how motor plans are organised] may best represent motor programs function. Best available knowledge for music educators is that motor programs take time and effort to be embedded into memory, and finding strategies to optimise their acquisition is necessary. (Davidson, 2012: 770)

and

> …equipped with knowledge of the role of motor programs and their integrative technical and expressive nature, and an understanding of the power of bodily movement in coordinating and communicating information, the music educator should make judicious decisions about how to teach. (Davidson, 2012:779)

What these quotations reveal is a contradiction between the inexistence of "definite answers" regarding "how motor plans are organised", and the idea that teachers "equipped with knowledge of the motor programmes" can subsequently "make judicious decisions about how to teach". As a teacher, I can read the above and understand that it is presently unknown how motor plans are organised – yet, nevertheless, I am obliged to know this to make informed decisions about my teaching practice. Overall, this seems rather confusing to me as an educator.

This present state of affairs is further aggravated by an extension of a research tradition in instrumental music education essentially focused on verbal communicative channels leaving gestural pedagogical aspects 'out of sight' and conceptualised under the term 'non-verbal behaviour'. Such terminology greatly contributes to a reductionist view of the role and importance of gesture by implicitly assuming a submissive role to gestures in relation to verbal content. However, as Barrett and Tafuri (2012: 310) state for music education in general, the aims of teachers should be "to provide opportunities for children to build a repertoire of musical gestures, phrases and genres…these may lay the foundations for their future engagement with music and thought". Moreover, elsewhere it is stated that children's musical learning and creativity can be actively enhanced by a process of "artful teaching scaffolding" (Wiggins & Espeland, 2012: 348) – that is, contexts in which teachers provide authentic and holistic learning opportunities that build upon what learners already know and can do, moving beyond their current levels of competence. Whilst such ideas at a first instance appear to be reasonable, they do not explain how such "artful teaching scaffolding" processes can take place in practical terms. Despite providing a progressive and transformative agenda for instrumental music teaching in theoretical and philosophical terms, such ideas lack considerations about the practicalities of the 'what to do' and particularly on 'how to do'.

Besides stemming from all of the above considerations, the rationale and importance of this research is grounded upon the indisputable fact that instrumental music teaching and learning are embodied practices that need to be empirically acknowledged as such. This is to say that educational theoretical and philosophical underpinnings need to be incorporated with an understanding of the contribution of the body in the process of music teaching and learning. Furthermore, such insights should inform the day-to-day practice of music instrumental teaching, as well as teachers' preparation regarding issues such as fostering and supporting creative learning environments and processes. This thesis constitutes a mere drop of water in a hitherto neglected critical lacuna, which has yet to fully dedicate itself to the embodiment considerations within instrumental music teaching and learning practice. Nevertheless it is hoped that the insights given can provide a solid framework for the development of this research area, prompting the attention of other researchers towards answering wider questions about how teaching practices can improve the creative instrumental teaching and learning context.

1.3 Setting the scene

In this section, considerations are made regarding the reflexive process that culminated in the gesture definition in use for the purposes of this thesis (1.3.1), followed by a characterisation of the research context (1.3.2), enunciation of the research questions (1.3.3), and an acknowledgement of influences from other disciplines (1.3.4).

1.3.1 A gesture definition for this thesis

Given the range of legitimate directions that this project might have taken, the pursued research route was based upon the core aim of building a solid ground for enabling this emerging area of knowledge to flourish. The first predicament found when trying to establish this research was to decide whether to study ‘gestures’ or ‘body movements’ and how to define and differentiate between the two. Gestures are indeed composed of movements, yet not all body movements can be considered gestures (Leman & Godoy, 2010) – still both are essential and integral elements for music making (Davidson, 2005). Within gesture’s definition is the idea that it is composed of movements that carry an intention and/or perceived meaning(s) *sensitive to the contexts* in which they are used. In the context of education, gestures linked with verbal language are vehicles of expression that contribute to the generation of new meanings, and it is amidst such ‘educational’ experience that symbolic and functional meanings are generated. Being the environment of education one that is intentionally communicative, it emerged that studying gestures instead of movements would provide an appropriate pathway to understanding the contribution of the body to the instrumental music teaching/learning process.

Gestures occur alongside a varied multimodal behaviour that includes not only speech allied to hand and arm movements, but also nods of the head, gaze directions, facial expressions, body postures, voice tone and intonation (among other behaviour) that can communicate meaning/s to people. Although all of such behaviours are important in communicative interactions, there are several reasons why I have decided to solely focus in hand gestures for the purposes of this work. The first reason is based on the ‘infancy stage’ of research into the role of gesture in the instrumental music teaching and learning and thus, an initial deeper understanding about hand gestures was assumed as beneficial to future multimodal research in this context. This was certainly the case in the field of psycholinguistics where after decades of work heavily focused on hand gestures (e.g. Alibali, Kita, Bigelow, Wolfman, & Klein, 2001; Beattie & Shovelton, 1999; Beattie, 1981; Goldin-Meadow, 1999, 2003a; Kendon, 1972, 1980; McNeill, 1987, 1998) an increasing interest into the study of multimodal behaviour has been witnessed particularly over the last decade (e.g. Allwood, 2002; Colletta & Guidetti, 2012). In the midst of intense research focused on studying the role of hand gestures in communicative interactions, a strong body of literature (which includes all of the mentioned sources in this paragraph) strongly suggests that hand gestures can convey information on their own. Thus, it becomes relevant to understand, the role of hand gestures in the context of instrumental music teaching and learning.

In considering spontaneous hand gestures, an important initial question was, of course: *what* and *what not* to consider a gesture? There is agreement amongst the scientific community that physical gestures are body movements that “express an idea or meaning” (Leman & Godoy, 2010: 5); yet there is disagreement regarding the requirement that a gesture, to be considered as such, needs to be performed consciously and intentionally by the gesturer (e.g. Kendon, 2004). A gesture might be intentional and meaningful for the gesturer, but could, for example, be interpreted as meaningless by the observer. Conversely, a certain body movement performed by a person without a communicative intention could assume a certain meaning for an observer. The meaningfulness of gesture becomes complex when looked from a semiotic linguistic and communicational point of view, in relation to the so-called “*signifier”* and the “*signified”* (where the signifier refers to the form a sign takes – here considered to be the gesture, while the signified is the represented concept, in terms of its meaning) (Chandler, 2006)[6]. The assumption that "nothing is a sign [in this case: gesture] unless it is interpreted as a sign [gesture]" (Peirce, 1931-58, 2.172) opens the door for questions such as: from what stance should the meaningfulness of gesture be considered: the gesturer, the observer, or both?

Whereas Kendon, (2004) argues that gestures should be considered as such only if performed consciously and intentionally, Hatten, (2006) considers that gestures are in many instances performed unconsciously, and should be explored on the basis of being perceived as significant by the perceiver. In this regard, Kendon, (2004) places the meaningful aspect of gesture with the speaker, whilst Hatten (2006) positions it on the listener, observer or perceiver. Earlier but nevertheless valuable work from the field of communication by Watzlawick, Bavelas and Jackson (1967) provides relevant insights on the above through their 'Interactional theory'. The first premise (called by the authors as 'axiom') of this theory poses that *one cannot not communicate*, based on the assumption that what *we don't say* can be as communicative as *what we say*. That is, people are embedded in a system of relationships and communicate verbally, non-verbally, explicitly and implicitly. As an example, a raised eyebrow (raised consciously or not) can convey information to others and such information is interpreted on an individual basis. Along these lines it is not only recognised that a substantial amount of communication is carried out below peoples' levels of consciousness, but also that every behaviour (even including absence of action) constitutes potential communication that can be interpreted and perceived as having meaning.

The above helped to understand and theorise the complex and nuanced nature of communicating meaning in the educational context, where this thesis is situated.

[6] Chandler, D. (2006). Semiotics for beginners. Retrieved March 04, 2014, from:www.aber.ac.uk/media/documents/S4B/sem02.html.

The view taken is that (within this context) gestures linked to verbal language are vehicles of expression and communication that contribute to the generation of new meanings, and that it is amid such 'educational' experiences that symbolic meanings are generated. Gestures can occur unconsciously and unintentionally as well as consciously and intentionally, and in either case be perceived as significant. Thus gesture is considered as: a spontaneous movement of teachers' hands and/or arms that can either accompany speech (McNeill, 1992) or music making activities (with or without speech). Such gestures occur in the pedagogical context of instrumental music teaching and learning, and carry either an intention (Gritten & King, 2011) or a perceived meaning (Hatten, 2006), or both. This way, I account for teachers' essential communicative intention in the teaching process, and also for the fact that even if communication was not intended (or at an unconscious level on the teacher's behalf), gestures that can still be perceived as meaningful for observers were considered. This approach chimes with Gritten and King's (2011: 1) position on musical gestures: "musical gestures can be conceived, produced, experienced and interpreted by individuals in various ways, whether aurally, visually, physically, conceptually or otherwise, and the functions of those gestures depend upon the contexts within which they arise". Such contextualised base intimates a need to focus on specific contexts of musical experience while attending to the various steps/stages/phases involved in the musical communicative process.

The second predicament was to decide: *whose* and *which* gestures to explore. That is to say, should the project focus on gestures used while teaching (teachers' gestures) or gestures used while learning (learners' gestures), separately or both? In answering these preliminary questions, it was assumed that whilst looking at both teachers' and learners' gestures in their day-to-day interaction is an ultimate goal, such achievement requires a prior identification and categorisation of what gestures are performed by each of these interlocutors. As such, it was decided that this research should encompass the study of teachers' gestures across student skill level and whether teachers' gestures have a role on students' learning outcomes.

1.3.2 Context

The context is that of piano teaching and learning in the western classical music tradition, often taking place in formal settings and frequently in a one-to-one basis (Creech & Gaunt, 2012). Formal learning[7] is defined as "occurring through a teacher's intervention and in structured settings, such as school" (Campbell, 2006: 416). The apparent bias towards a western classic music tradition in this thesis is justified on the fact that (with few exceptions[8]), most research work dedicated to gestures in musical performance was carried out in the western classic music tradition, and highly focused upon piano performance. Thus, further focus on this frame of reference can provide solid ground for a much needed recognition of the importance of teaching and learning processes for the resulting musical performance in the western classical musical tradition, and initiate a debate that can impact present pedagogical practice.

Examples of music performance research dedicated to gesture and body movements undergone in piano performance scenarios include: Davidson's seminal work on the role of visual perception in music performance where observers were shown video of performances by a pianist and four violinists (1993, 1995) in a point-

[7]Regarding **formal learning**, Folkestad (2006: 143) further poses that formal and informal learning processes besides being equally important, contain in itself, to a certain degree in most situations, formal and informal learning approaches and that these terms "should not be regarded as a dichotomy" but rather "as two poles of a continuum".

[8] Exceptions include Clayton, (2005) and Rahaim (2008, 2012).

light display[9] technique based on Johansson (1973); Williamon and Davidson's (2002) study of two pianists as they prepared for a performance in which the participants, who did not know one another prior to the experiment, spent up to 90% of rehearsal time expressing musical ideas through non-verbal communication in the form of gesture and body language; Elsdon's (2006) study about the jerky movements of jazz pianist Keith Jarrett; Davidson (2006), who studied the performance style of Robbie Williams; and Chaffin and Logan's (2006) observation of how pianists and concert soloists prepared for performance. Landmark research in this area from the perspective of piano performance is Delalande's (1995) work concerning the semiotic gestures of Glenn Gould. It is assumed that researching gestures in the piano teaching and learning context can complement findings of the above research while providing a framework that can be applied to the teaching and learning of other musical instruments. In addition, my practical knowledge as a pianist and experienced piano teacher has given me important insight in terms of setting the goals and in judging and choosing appropriate research methods**.**

1.3.3 Research questions and brief methodological considerations

Two research questions drove this thesis:

1. What is the role of teachers' physical gestures in the piano teaching context – in terms of communication in general, and in the communica-

[9] **Point-light displays** are obtained by video recordings of body movements of people to whom markers or point lights have been attached to major joints. The video materials are subsequently treated in order to retain visible only the point-lights in the resultant display.

tion of musical symbolic and functional knowledge across students' skill levels?

2. What implications can teacher's gesture have on student learning outcomes?

Answers to these questions were sought through three empirical investigations using mixed qualitative and quantitative methods. Regardless of the opposition that can exist between quantitative and qualitative research methods, obviously there are common elements. Both involve data collection, analysis, and interpretation, and it is suggested elsewhere that using mixed research approaches is advantageous given the added opportunity of examination of a phenomenon in multiple ways (Lieber & Weisner, 2010). The undertaken investigation is not only grounded upon a relevant theoretical framework from varied fields of knowledge (see Section 1.3.4), but also exemplifies how research completed in a naturalistic setting, using systematic observation, can provide material for further investigation in experimental settings. Naturalistic settings are aimed at observing participants in their day-to-day pedagogical interaction, in order to ascertain how participants' normally behave. As such, the video recordings undertaken for the purpose of the studies reported in Chapters 3 and 4 were carried out in typical day-to-day pedagogical situations, in which there was no research intervention or the presence of researcher in the same physical space. Participants were unaware of the research focus on gesture as it was assumed that such knowledge could contribute to gestural self-awareness, and thus alter the results. Systematic observation involves repeated observations of the data material based on defined observation parameters (see Thomas, 2009). For this investigation, it was defined that teachers’ hand gestures would constitute the material of observation (allied with co-occurring verbal content), and the main aim of the observations was to find gestural similarities and differences amongst teachers’ participants. In addition, the gestural material was not only observed by the researcher, but also by two independent annotators who categorised the data into predefined categories in order to investigate the extent of agreement or disagreement between observations (in accordance with Bakeman and Gottman's 1986 requisites for observational techniques). From the observed naturally-occurring data resultant from the first two research investigations, a gesture category (i.e. ‘Mimic gestures’) was selected for further investigation in experimental settings. The choice of this gesture is based on its relevance for demonstration, imitation and modelling learning processes in this context (Chapter 6). A similar approach was taken by Parton and Edwards (2009) in a smaller-scale study of music conductors’ gestures in which video-recorded, naturally-occurring data was analysed using an ethnographic research approach and explored using quantitative analytical techniques. Although comparable in general terms, the nature of the research contexts (conductors’ performance versus piano teaching and learning pedagogical scenario), research questions, and overall scale of the investigation undertaken in this thesis, considerably differ from those used by the above authors.

1.3.4 Influences from other disciplines

This thesis is situated within the field of modern psychology of music. Dating from the 1950s, this area of research has been dynamically transformed – with particular intensity over the past decade. Regarding this transformation, as Hargreaves, MacDonald & Miell (2012: 138) put it, “the explosive growth of music psychology in the 2000s and 2010s parallels the growth of psycholinguistics in the 1960's, or even the 'cognitive revolution' of the 1980s". The significant shift in thinking took place in reaction to the quantitative and formalist nature of existing research traditions in the early nineties, while exemplifying how a cognitive research tradition would benefit from adopting qualitative, social and developmental directions in naturalistic settings (Clarke, Dibben & Pitts, 2010). Such a step was given in works such as Bamberger[10] (1991) who laid vital foundations of the present variety of both research avenues (i.e. quantitative, qualitative) and research methods which include mixed methods. Within the quite heterogeneous field of music psychology[11], this thesis is located within the broad cognitive research tradition of music psychology. It is specifically focused through an educational, social perspective, and upon issues of meaning creation, which gradually increased in the field since 2008 (as claimed by Clarke, Dibben & Pitts, 2010). This work fits specifically within the applied aspects of music psychology, reflecting recent, cutting-edge research into the importance of the body. Yet, this works goes beyond the present focus given to gesture and body movements in musical performance by driving such focus towards the instrumental music teaching and learning environment.

At the heart of this discussion reside three important principles: 1) Cognitive, age-related developments are shaped by the specific socio-cultural contexts in which they occur (see Vygotsky, 1966, 1986) which has informed the latest developments in music psychology research (see North & Hargreaves, 2008). In this trend of knowledge it is claimed that musical biological predispositions towards musicality are developed and shaped by other people, groups, institutions and situations that

[10] In her book *The mind behind the music ear* (1991), Bamberger uses individually tailored qualitative methods to study children's musical minds.

[11] For more see Clarke, Dibben and Pitts's book entitled *Music and mind in everyday life* (2010: 169-194), Section: "the psychology of music – an overview".

they encounter in the course of their development within a certain culture (see Hargreaves, Miell & McDonald, 2002). Hence, a higher focus should be placed upon the influence of relevant others in shaping instrumental learning process in various settings, including teachers' influences upon student learning processes, in various teaching and learning settings. 2) The recent musicological shift from text to an embodiment paradigm in which "music is always received in a discursive context and ... [that] it is through the interaction of music and interpreter, text and context that meaning is created" (Cook, 2001:180), implies that the educational experience in instrumental music education constitutes a musical performance in an interactive and embodied discursive experience, through which meaning is constructed. As pointed out by Swanwick (2001), music is not an object to be transmitted – it is a dynamic event. In such a dynamic process, kinetic, tactile and sensed qualities of meaningful experience and expression take place (Johnson, 2007) that constitute experiential ideas, ideas that provide understandings in action-perception cycles. And 3) Although the processes underpinning learning in music are shared across cultures, constituting part of natural learning processes that are common to all human beings (Hallam & Bautista, 2012: 658), the musician-teacher is: "an exemplar who embodies a contextualised understanding of music, literacy, orality, performance practice, creative musical expressions and scholarship" (Jorgensen, 2008: 388). Therefore, researching the process of teaching and learning to play a musical instrument implies viewing each context as *culturally contextualised* in what Dunbar-Hall (2006: 388) calls "ethnopedagogy". Such an understanding implies that gestures that generally instil coherence, understanding and meaning may be different in different musical cultures.

Other essential contributions to this thesis are given by the modern field of gesture studies which emerged in the 1970s in David Efron's (1941/1972) sequence of systematic investigations into the role of gestures in human interaction, psycholinguistics and gesture led technological developments. Key findings suggesting that gestures and speech are part of the same process – forming a unified and single system (Goldin-Meadow, 2003; Goldin-Meadow & McNeill, 1999; Kendon, 2004; McNeill, 1992, 2005) – were very relevant to understanding the specificities of musical communication and establishing the here proposed categorisation of piano teachers' gestures. Such effort was substantially aided by the use of gesture recognition technology, particularly Elan software[12] (see Lausberg & Sloetjes, 2009) developed by the Institute of Psycholinguistics, Nijmegen (Netherlands) in the early twenty-first century. This and similar tools (such as Anvil software[13]) enable the observation of video recordings of data material on a timeframe scale. The observed gestural material can be coded alongside speech transcription, and it is possible to have independent annotators categorise the data, and to carry inter-annotator reliability assessments (in accordance with Bakeman and Gottman's 1986 requisites for observational techniques).

Obviously the use of such software does not solve the terminological disagreements in relation to the multiplicity of aspects that gestures can be looked at. As King (2013: 69) states, in gestural analysis it is possible to deal with an array of different variables such as gestures: "size (large/medium/small); duration (long/medium/short); speed (fast/medium/slow); plane of direction (horizontal/vertical/diagonal/circular/semi-circular); and handedness (right-hand only/left-hand only/both hands in parallel motion/both hands in contrary motion/both hands

[12] Elan software can be accessed and downloaded at http://www.lat-mpi.eu/tools/elan/

[13] Anvil software can be accessed and downloaded at http://www.anvil-software.org/

linked)". From here, gesture can be linked to verbal content in terms of when and how gesture occurs alongside speech, and in relation to specific contexts and other possible human behaviours. The possibility of evaluation (by others) of the implicit subjective element of a researcher's observation provided through the use of tools such as Elan software offers opportunities for potentially fruitful discussion and communication amongst professionals. The resulting insights can positively inform further research, while assessing research validity and reliability.

Given the above theoretical and practical motivations and concerns, this thesis attempts to establish an instrumental music context-based-definition of gesture, and to develop a gestural classification that can serve as a framework for developing gesture studies in this context.

1.4 Thesis overview

The highly interdisciplinary nature of this thesis has posed a range of challenges in terms of structure and organisation. Two chapters (2 and 5) are specifically dedicated to literature review which, besides from articulating a multiplicity of questions that require empirical answers also provide justification for the path taken by this research project. The literature reviews also outline the significance and implications of my research trajectory, helping to pre-empt the conclusions that I later formulate. Three empirical chapters (3, 4 and 6) report upon the specific investigations carried out, and are each grounded upon relevant theoretical literature presented in the chapters' early sections. In the final chapter (7), I provide conclusive responses to the research questions, which I also contextualise in terms of wider literature, relevance, implications and limitations.

In sequence of the material already outlined in this first chapter, Chapter 2 highlights the need for bringing gesture in piano teaching into academic focus, whilst presenting a literature review in gesture research across varied musical disciplines and other fields of gesture-led research (such as psycholinguistics, education and neuroscience). Here I argue that there is a need for understanding the gestural processes through which musical knowledge is communicated from teacher to student, and that such an understanding needs to consider the teaching process as essentially involving three overlapped dimensions in constant reciprocal interaction: social, communicative, and embodied processes. The overview of literature, from which these considerations result, then culminates in a reflection upon the research directions taken, and how they guide the subsequent chapters.

Building upon this groundwork, Chapter 3 initiates an empirical exploration dedicated to understanding the roles of gestural processes for the communication of musical knowledge from teacher to student. Beginning by expounding the necessity of establishing a gestural classification in a study such as this, the chapter draws upon extant literature on gesture classification, from fields of music performance and psycholinguistics. Analysing the parallel processes that occur between gesture, music, and speech alongside the relevant considerations of a context-dependent study, I unpack and explain gestural study and classification in detail. The outcome of my empirical investigation is the first known categorisation of piano teachers' gestures – and hopefully a useful research tool that future research in this area can utilise. Following this, I argue for extending and adapting McNeill's (2005) ideas of 'imagery–language–dialectic' to 'imagery–music–dialectics' with relevant implications for piano pedagogy and fields of study invested in musical communication.

Chapter 4 moves forward from the relationship found in the previous chapter between piano teachers' didactic intentions and the forms of gestures they use to communicate information to students at piano grade 1. This investigation is geared towards understanding whether similar relationships are found in piano teachers' gestural behaviours while teaching students of different proficiency levels. Grounded in a literature review focused upon how teachers contribute to students' acquisition of symbolic and functional knowledge, this empirical study records and reflects upon a teachers' gestural scaffolding approach whereby teachers adapted gestural communicative channels to suit specific student proficiency levels.

In Chapters 5 and 6 I shift attention from solely considering piano teachers' gestures (in terms of gesture types, frequencies and relation to teaching behaviours) towards the ways in which teachers' gesture can mediate students' piano learning. Beginning with another literature review survey, I consider the role of gesture for the creation of musical meaning; this is followed by insights about the relationship between gesture and learning from other fields of knowledge. Chapter 5 concludes through a summary and discussion which emphasise the need for empirical work dedicated to analysing the role of teachers' gestural demonstrations for students' learning outcomes in the piano teaching and learning context. Chapter 6 then undertakes exactly that, empirically exploring the relationship between 'gestural teaching-demonstration' and 'student observation and imitation' through an experiment into the effects of student observation and imitation of a teacher gestural demonstration, using Mimic gesture. The results of this investigation suggest an important learning role for students' observation and imitation of teachers' Mimic gesture. I reflect upon these results through literature relating to student learning in fields where demonstration is used frequently as teaching and learning strategy (e.g. sports, physical rehabilitation and of course, instrumental music education). Bringing together the main points of discussion from the empirical results, Chapter 7 provides answers to this thesis main research questions (as outlined in Section 1.3.3); moreover, it also contextualises its findings against wider literature and evaluates their relevance, significance and implications. Future research avenues are proposed and considerations made regarding the limitations of this thesis's empirical parameters. The chapter concludes with a final reflection upon (and scrutiny of) this thesis's main research statement.

Chapter 2

Gesture in piano teaching

Drawing upon the social, communicative, and embodied dimensions of piano teaching, this chapter argues for the acknowledgement of gesture as an important aspect of the instrumental pedagogic process (section 2.1). Foundations for investigating the roles of gesture in piano teaching and learning are explored through the topic's treatment in gesture-led research across related and disparate fields, and varied musical contexts (section 2.2), psycholinguistics, education, and neuroscience (section 2.3). This overview of literature culminates in a reflection upon the research directions taken for this investigation, and how they guide the subsequent chapters (section 2.4).

2.1 Bringing gesture in piano teaching into focus

In the instrumental music teaching and learning, gestures assume a multiplicity of roles: they are an essential and integral aspect for the communication between teachers and students in the same way that they are essential for playing, teaching, and learning to play the intended musical instrument. They are, moreover, involved in the acquisition of practical knowledge in relation to the motor aspects of instrument playing, alongside conceptual knowledge needed to perform and interpret the musical material, and the communicational aspects required for learning how to communicate music. If such is the importance of gesture for music making, and music making is in itself rooted in educational practices, why has only scant consideration been given to the gestural aspects of instrumental musical pedagogy?

Three inter-related factors contribute to the existing state of affairs. Firstly, research into the instrumental music teaching context mostly focused on verbal communicational aspects around a nexus of issues including: teachers' conceptualisations of teaching (e.g. Hallam, 2006); how individual differences influence teaching practices (Jorgensen, 2002; Kostka, 2002; Madsen, 2004); the role of context in shaping methods and curriculum practices (Burwell, 2006; Gaunt, 2008; Green, 2001; Lamont, 2002); corrective feedback (Bergee, 2003; Parkes, 2011; Sink, 2002); dual roles of teachers as teachers and performers (Jorgensen, 2000; Parkes, 2009; Parncutt, 2007); interactions between teachers and students in the classroom (Byrne, 2005; Creech & Hallam, 2003, 2011); and teaching effectiveness (for reviews see Kennell, 2002 and Parkes, 2009). Secondly, research focused on the study of body movements and gestures in music performance, in the context of the western classical music tradition (e.g. Dahl & Friberg, 2007; Davidson, 1994, 2001, 2005; Poggi, 2011; Wanderley & Vines, 2006), mostly consider performance as a final construct –

and aspects such as how teaching and learning influence movement/gestural features during musical performance remain overlooked. In addition, historical literature[14] focused on the use of body in instrumental music teaching and learning relies to a great extent upon subjective and vague perceptions of what works in the personal experience of music teachers and other pedagogues, rather than on an accurate and systematic understanding of: 1) The role of gestures and body in general, in the communication established between the dyad teacher and student in the music instrumental pedagogical setting; and 2) The biomechanical principles of human movement required to safely teach and learn playing a musical instrument. Thirdly, in the earliest attempts at studying gesture in the instrumental teaching context, gesture started to be considered under the term non-verbal behaviour (e.g. Carlin, 1997; Gipson, 1978; Hepler, 1986; Kurkul, 2007; Levasseur, 1984). This term contributed to a reductionist view of the role and importance of gesture by implicitly assuming a submissive and secondary role to them in relation to verbal content. Further, the term is misleading as some of the categories set by previous researchers, such as ‘facial expression and eyes’ (e.g. Levasseur, 1994) and ‘physical initiating’ (e.g. Gipson, 1978), often occur *alongside verbal behaviours*, not separately from them.

The first study that solely examined ‘non-verbal communication’ observed that successful voice teachers performed the following non-verbal behaviours during lessons: ‘steady eye contact’, ‘forward posture’, ‘head nodding’, ‘smile and laughter’, ‘appropriate touch’, ‘animated facial expressions’, and the use of ‘expressive gestures’ (Levasseur, 1994). These observations paved the way for the following

[14] This literature includes Philip Emanuel Bach *Essay on the True Art of Playing Keyboard Instruments* [*Versuch über die wahre Art das Clavier zu spielen*] (1753), translated by William J. Mitchell (1949); William Mason’s *Touch and Technique* (1897); Tobia’s Matthay’s *The Act of Touch in all its Diversity* (1903); Maria Levinskaya’s *The System of Pianoforte Technique and Tone-colour Through Mental and Muscular Control* (1930); Joseph Gat (1958) *The Technique of piano playing*.

hypotheses: verbal and non-verbal teaching behaviours are equally important (Wang, 2001); non-verbal sensitivity plays a significant role in the teaching of music performance (Kurkul, 2007); piano teachers who perform more non-verbal behaviours are considered by students to be most effective (Carlin, 1997); and non-verbal sensitivity plays a significant role in the teaching of music performance (Kurkul, 2007). These so-called non-verbal behaviours are clearly important for human-to-human communication in the instrumental teaching context, and can have a significant impact in terms of teaching effectiveness. Thus there is an obvious need for understanding more about the gestural processes through which musical knowledge is communicated from teacher to student. Such an understanding requires the consideration of piano teaching as a process essentially involving three overlapped dimensions in constant reciprocal interaction: social, communicative, and embodied processes.

2.1.1 Social, communicative and embodied dimensions of piano teaching

Piano teaching is fundamentally social and is, therefore, an inherently communicative and embodied process by which teachers communicate music and music making processes to their students. Whilst doing so, they support and foster student learning about how to make and communicate music musically. Teachers do this through a variety of communicative channels, systems, and processes that are used to communicate, teach and assess knowledge about music embedded in social and cultural contexts. The view taken here is that ‘meaning’, or predefined assumptions embodied in movements used for communication, shall be considered from a ‘situated cognition’ perspective (see Lave & Wenger, 1991). Given that certain capacities are afforded and constrained by the situations in which they take place – and thus all musical practices are “fundamentally social and inherently communicative” (Barrett, 2005: 265) – this implies that meaning-making is bound to its context; so too, therefore, is the piano teaching and learning context. For when teachers engage in the activity of teaching to play a musical instrument, they are engaging in a specific form of social interaction that calls upon vital communicational skills and interpersonal engagement. In fact, as demonstrated in several teaching domains, efficient teaching, good communication and interpersonal engagement are intimately dependent upon one another (Sanders, Wright & Horn, 1997; Vogt, 1984; Wenglinsky, 2000). Furthermore, although ‘talking about music’ and ‘communicating musically may be different activities’ (Byrne, 2005: 310-311) they have common communicative goals that share gestural, verbal and musical communicative channels in interaction. Hence it is important that teachers understand the explicit and implicit roles “they play in creating, setting, directing, mediating and regulating the learning environment” (Byrne, 2005: 317). And, crucially, ‘music’ (the content to be learned in an embodied practical experience of teaching and learning to play a musical instrument) is in itself a fundamental channel of communication that enables people to share emotions, intentions and meanings (Hargreaves, MacDonald, & Miell, 2005). Such aspects certainly need to be taken into account in any considerations regarding musical communication.

There can be little doubt in the validity of viewpoints that assert how teaching “involves a complex set of knowledge, abilities, and personal attributes in dynamic interplay” (Davey, 1991: 121), and suggest that “the most crucial clarification about teaching occurs at the level at which we decide what kind of interaction it is” (Dunne, 1997: 367). Embedded in the educational context is a discursive and interactive element intimating that musical meaning cannot be dissociated from life, and therefore from the world. This was clearly evidenced in the dialectical philosophical teaching of one of the most influential piano teachers of all time: Heinrich Neuhaus (1888–1964). Neuhaus (1973: 41) stated that more than merely teaching piano, "the teacher must arouse the spiritual qualities of the pupil [. . .] he must make him feel, think and experience". And the Neuhausian holistic importance of the teacher is propounded elsewhere with similar, striking conviction:

> The making of a performing musician in the West is the result of events that transpire between student and teacher in the privacy of the studio lesson. For a period of thirty minutes or an hour each week the student has the undivided personal attention of the teacher [...] Teachers are the musical agents, the models, and the motivating forces for their students. (Campbell, 1991: 276)

But how in this highly dynamic, interactively musical and communicational scenario are music, emotions, conceptual thinking, and knowledge communicated? Based on work developed by Pratt (1992), traditional conceptualisations of piano teaching within the frame of master-apprentice model (see Hallam, 1998; Kennell, 2002) point to different conceptions of teaching, which presuppose different levels of human agency: 'engineering' (delivering content); 'apprenticeship' (modelling ways of being); 'developmental' (cultivating the intellect); 'nurturing' (facilitating personal agency); and 'social reform' (seeking a better society)' (in Creech & Gaunt, 2012: 698). Hallam (1998) argued that the apprenticeship model mostly reflected the practices of instrumental teaching. And I take 'Modelling ways of being' to imply that teachers not only impart practical and functional musical knowledge but also help shaping processes associated to the development of a musical identity (see Hargreaves et al., 2002), thus their importance in the music educational process merits careful attention.

Several researchers consider instrumental music teachers as key factors for student learning success or failure (Cardoso, 2012; Davidson & Scutt, 1999; Duke, 2009; Folkestad, 2006). Such perceptions of teaching roles involve an array of different tasks such as, but by no means limited to: shaping student's beliefs about their own ability and skills while instilling self-evaluation and metacognitive skills through various types of feedback (Hallam, 2001, 2006; Lehmann, Sloboda, & Woody, 2007; McPherson & Renwick, 2001; Reid, 2001; Sloboda, 1991); setting and adjusting specific, mid- and long-term goals for appropriate levels of support and challenge to occur (Duke, Simmons & Cash, 2009; Mills, 2007); helping the student becoming progressively autonomous (Hallam, 2001; Lehmann et al., 2007); and the provision of advice about how to practise effectively (Barry & McArthur, 1994; Hallam, 1998). Teachers need to know how to adapt their teaching methods to students' individual characteristics and learning needs. They must also provide appropriate 'scaffolds' during the process of skill development while still promoting students' individual autonomy – these are key ingredients of teaching and learning effectiveness (Burwell, 2006; Hallam, 2006; Jorgensen, 2000; Lehmann et al., 2007; McPhail, 2010; North & Hargreaves, 2008; Sloboda, 1991). Teachers also play an important role regarding students' intrinsic motivation, in itself a relevant predictor of future engagement in instrumental music learning, with research suggesting that teachers play an important role in nurturing learners' intrinsic motivation levels (Booth, 2009; Chaffin & Limieux, 2004; Cheng, 2005; Davidson, 1999; McPherson & Davidson, 2002; Sloboda & Davidson, 1996; Sosniak, 1985). This is particularly the case for teachers that provide positive learning experiences to their students while allowing for the student to have control over the learning process (Hallam, 1998, 2006; McPherson & McCormick, 2006; Mills & Smith, 2003). Conversely, inappropriate and uninspiring teaching has been found to be the major cause for student drop-outs (Costa-Giomi, Flowers & Sasaki, 2005; Davidson, 2002; McPhail, 2010; Rostvall & West, 2003). The above clearly demonstrates the impact that teaching can have on learning and that learners' success or failure highly depends on how effectively teachers can, through a multifaceted communicational process, help students overcome their learning difficulties at various levels.

Based on the type of communicational interaction established between teachers and students, another model conceptualising instrumental music teaching in terms of mentorship approach has emerged. This model observed the following descriptors in violin tuition: high levels of interaction between teacher and student; mutual feedback that contributes to reciprocity in the relation between teacher and student; developmental cycles; a nurturing context; and a mutual benefit from the relationship for both teacher and student (Gholson, 1998). Mentoring has been defined as helping mentees make their own decisions in the learning process while promoting independence, building confidence and generating an environment of trust, commitment and active involvement between mentor and mentee (Creech & Gaunt, 2012: 699). The apprenticeship model has also been influenced by the above described conceptualisation of mentorship and has experienced a gradual, dynamic theorisation by Nielsen (1999) as having four main attributes: 1) participation in a community of practice where learners become increasingly independent, and where mentorship also takes place and is adapted to specific situations; 2) professional identity is developed through the learning of new skills; 3) there is a high element of teacher demonstration, student imitation, and master feedback – where the master will give considerably more input at the beginning of the development of a certain skill, and gradually less as the learner starts becoming more independent through practice; and 4) evaluation of learning takes place through practice and practical work (Nielsen 1999:19).

It is noteworthy that both apprenticeship and mentorship models place (respectively) an explicit or implicit focus on gestural elements. Such foci, though reached from different angles, are complementary from a pedagogical perspective: whilst the apprenticeship model places specific emphasis on demonstration and imitation, thus assuming that competence in learning needs more than verbal communication alone, mentorship places a high value on the holistic aspect of the interactional and communicational elements between student and teacher. Within these elements of holistic communication, gesture is an essential aspect of the 'conversational interaction'. Thus, a model is needed that dynamically combines principles of apprenticeship and mentorship accounting for verbal, gestural and musical communicational aspects and learners' individual aspects such as age, skill level and particular learning goals.

With regards to the physical processes involved in musical physical embodiment, the translation of musical intentions into music is much more complex than mere sound production; from a teaching point of view, it implies "directing a learner's attention to the central and expressive aspects of the sounds they produce, guiding their listening, their thinking and ultimately, their motor behaviour in a process of meaningful listening" (Duke & Byo, 2012: 721). This suggestion aligns closely with recommendations on developing musical expressivity, arguing for the need to include approaches that can promote young students' creation of personal meaning in their music making (McPhee, 2011). The difficulty in teaching musical expression seems to rest on the fact that knowledge about expression is difficult to convey, given that it is mostly implicit rather than explicit (Juslin & Persson, 2002). Perhaps due to such difficulty, teachers have been found to give greater importance and prominence to the development of technical skill, at the expense of creative, expressive, and musicianship aspects (Karlsson & Juslin, 2008). This tendency is evident when the considerable body of literature focused upon technical issues is compared in scale to the scarce outputs centred upon expressive music making[15]. Some observed strategies used by teachers for teaching expression include: "vocabulary choice and usage, various forms of modelling, and management and implementation strategies" (Tait, 1992); aural modelling (Ebie, 2004; Karlsson & Juslin, 2008), and verbal direction (Woody, 1999); concentrating on emotions (Gabrielsson & Juslin, 1996; Juslin, 2003; Juslin & Laukka, 2003; Woody, 2000) and using verbal metaphors (Barten, 1998; Persson, 1996; Watson, 2008). Such observations neglect to consider the role of gestural communicational channels in inculcating expression, particularly: that teaching expressivity cannot be dissociated from a focus on the musical goals and a linked understanding on the physical behaviours needed to create such musical goals (Duke & Byo, 2012).

A range of factors are dependent (to various degrees) on how learners use their bodies during music making, including: "[o]ptimal relaxed position of the body; beautiful tone; intonation; note accuracy; rhythmic precision; clear articulation; dynamic variation; expressive inflection" (Duke & Byo, 2012: 718). However, besides anecdotal information there remains a distinct lack of empirically based research into how to teach efficient body usage applied to music making in this context. For pianists and other instrumentalist musicians, the whole body operates and cooperates in music making – unified fingers, hand and arm movements, including elbow and up-

[15] There is a wide variety of literature essentially focused on piano technique. To name only a few: *Fundamental principles of the Leschetizky method* (1902), part of the Modern pianist series published by Dover Editions with the title *Leschetizky's fundamental principles of piano technique* (2005); Oscar Beringer *Daily technical studies*; Carl Czerny *The art of finger dexterity, op. 740;* Moszkowski *Virtuosic etudes, op. 72.*

per arm, are vitally important for achieving freedom of playing. Such freedom is based on principles of body flexibility and appropriate transfer of entire body, shoulder or arm weight into the fingers from note to note, whilst knowing the ‘beginning and the end’ (Fink, 1992; Neuhaus, 1973) of connected movements, and having in mind the intended tone quality and intonation. Freedom is achieved by avoiding additional physical force on the key subsequently to the onset of a note (Jabusch, 2006). But how can teachers effectively ‘feel’ or ‘know’ the amount of pressure students are using to produce sound/music?[16] And what practical advice should be given considering students’ age and particular levels of skill? Not only do these essential questions have obvious musical importance, in terms of tone and intonation quality, but they also matter in terms of psychological and physical life musical engagement – in ways that have not yet been given adequate empirical attention.

Work on rhythmical musical perception generated a gradual shift in attention towards bodily aspects of musical performance, and body based models have been proposed which suggest a link between human locomotion and timing in music performance (e.g. Friberg, Sundberg & Fryden, 2000; Kronman & Sundberg, 1987; Shove & Repp, 1995; Todd, 1995). But given that the research focus was mostly based upon exclusive learning processes and musical performance, there remains a lack of understanding about how such body based models of musical performance are developed in the instrumental music teaching setting – not to mention about how they are employed to produce good quality tone, intonation, note accuracy, rhythmic precision, clear articulation, dynamic variation and expressive inflection.

[16] Suggestions have been given regarding the importance of warm-up prior to stretching for prevention of injuries, given that cold muscles are more prone to tear (see Colwell & Hewitt, 2014; Neuhauss, 1973). In addition, the use of Tai Chi, Yoga, Alexander technique, and muscle mapping - all promoting adequate body alignment, effortless body movements and flexibility have been advocated for use in the instrumental classroom (Colwell & Hewitt, 2014; Pierce, 2007; Woodard, 2009).

Although the discussion of body movement in teaching music is not a new development per se, the lack of attention paid to the perception and cognition of gesture in instrumental music teaching is striking. Teaching and learning to play piano are embodied activities[17], for which the body and brain play a dynamically significant role. Undoubtedly, the body plays an essential and important role in the way in which piano playing can be experienced – be that through learning, teaching, practising or performing. Implementation of the emergent paradigm of instrumental music education advocating the need of promoting learners' musical communication as a "prominent instructional goal" (Duke & Byo, 2012: 712), requires understanding of the communication processes implicated in musical communication between teachers and students. Research undergone in the context of language teaching has, for instance, found that foreign language teachers who consciously control their movements and stance enjoy a subtle but effective power: they were shown to be able to noticeably control the speed at which they intended the lessons to unfold, and to concomitantly reduce their verbal input to the lesson. These teachers use conversation, choral repetition and gestures to signal and instigate changes in the classroom atmosphere, and thus further their instructional goals (Barnett, 1983).

Thus, in the instrumental music teaching context (where high levels of interpersonal engagement, demonstration, imitation and modelling occur in comparison with language teaching), it can cautiously be assumed that gestural communication can have other – and possibly more specific – functions. Such functions, as as demonstrated in the review undertaken for the purposes of this sub-section appear to

[17] At the heart of embodiment theory is the idea that knowledge is generated through the perception of the experience of an individual in his/her world conveyed through body senses and resides not only in the mind but also in the body (see Merleau-Ponty, 1945; Varela, Thompson & Rosch, 1991). Taking the body with its perceptual and motor capacities as the point of departure for human cognition implies to assume that our mental processing is inseparable from the body and emotion, language, memory and other processes are meshed (Thelen, 1995).

include (although not exclusively): direct impact on musical identity and meaning generation processes; affect interpersonal engagement and engagement in music-making activities; roles into teachers and students conceptualisations of teaching and learning; exert direct influence into physical processes of musical embodiment and the translation of musical intentions into music (e.g., expressivity, intonation) with its associated physical and emotional aspects. Thus, understanding the relationship between teachers' teaching effectiveness in relation to different types of communication is a priority. Such knowledge is vital for the generation of an informed and empirically based piano pedagogical practice that accounts not only with verbal communicative channels but also with its complementary gestural social, communicative and embodied dimensions.

2.2 Gesture research across different musical landscapes

In music, gesture refers to a concept of motion (Schneider, 2010). However, such motion can be troublesome to define, and may assume different forms, meanings and functions. For example, composers creating a musical work are creating musical motional patterns in a metaphorical way, through which expression is conveyed. Performers, on the other hand, physically embody the gestures of either music written material or imaginary music mental images (for example when improvising); and in so doing, music is brought to life. Such varied ways of generating, perceiving and gesturing imply that approaches to gesture need to take into account the fact that meaning in gesture is necessarily bound to context (Leman & Godoy, 2010).

To emphasise this context-sensitive nature of gesture, I use the term landscape in this and following subsections. Landscape is often defined as the visible features of a land, within reach of one's gaze: "A view or prospect of natural inland scenery, such as can be taken in at a glance from one point of view; a piece of country scenery" (Oxford English Dictionary online)[18]. This term serves a twofold purpose: 1) emphasising the different definitions and functions that gesture can assume in different contexts, even when united by a common element – music; and 2) depicting that the gestures I am referring to in this chapter are *visible bodily actions*, and so composers' gestures considered as those contained in the musical score and still awaiting to be embodied, are felt to be beyond the scope of this thesis.

2.2.1 Conducting

> The conductor's job is to transform the mental image of the musical work into gestures.
>
> (Johannsen & Nakra, 2010: 268)

Conductors' gestures are the most noticeable from all musicians: using gestures performed predominantly with the hands and arms in addition to facial expressions, conductors inspire a group of musicians to use their expertise and convey music with expression (Johannsen & Nakra, 2010). Their system of gestures and associated symbolic meanings has been gradually evolving for the past 300 years, although it was from the 19^{th} century onwards that greatest development occurred, particularly in terms of the establishment of a system of formal rules[19] from earlier stylistic conventions. In relation to their gestural behaviours the following categorisation has

[18] "landscape, n." *Oxford English Dictionary Online (OED online)*. Oxford University Press. Retrieved May 15, 2014 from http://www.oed.com/

[19] The first attempt of describing and formalising the conventions of conducting was that of Hector Berlioz in his essay *Le Chef d'Orchestre: Theorie the son art* (1844, revised in 1855). This work was subsequently translated into other languages and appeared in different editions with different names such as *Grand Traite d'instrumentation et d'orchestration Modernes* . For more recent conducting manuals see Green, E. (1996). *The modern conductor*. New Jersey: Prentice Hall; and Rudolf, M. (1994). *The grammar of conducting* (3rd Edition). Toronto: Schirmer Books.

been proposed by Schneider (2010: 72), 1) "actions that relate directly to the musical structure as well as to its reproduction by musicians in a performance" – for instance, gestures performed by conductors' hands that regulate and depict the musical agogics[20] and dynamics; 2) "actions that relate to the music and the performance in a more mediated way" – gestures used to convey the overall flow and dynamics, such as swaying of arms or the upper part of the body; and 3) "actions that relate to the music in a more or less symbolic way" – gestures that imply enacting emotions such as resoluteness state, such as when the conductor throws his head back.

Conductors' gestures have been a subject of curiosity by researchers particularly over the past two decades (Parton & Edwards, 2009), and although the great bulk of research is of a qualitative nature and focused on isolated individual examples of conductors (e.g. Boyes Braem & Braem, 2000; Haviland, 2007; Poggi, 2001, 2011) there are nevertheless a few experimental studies (e.g. Luck & Nte, 2008; Luck & Sloboda, 2007; Luck & Toiviainen, 2006). Qualitative research approaches have, in general, attempted to establish a relation between expressive conductors' gestures and other forms of communication such as sign language or even speech. Whilst Poggi (2001) attempted to develop a lexicon of conductors' gestures, Boyes Braem & Braem (2000) compared the form of expressive gestures performed by conductors to standardised sign-language. Regarding parallels between conductors' gestures and speech, Parton (2007) proposed that there is a certain degree of consonance between co-verbal gestures and normative gestures in a study focused upon conductor gestures using McNeill's continua (McNeill, 2005). However, it is ques-

[20] The term 'agogics' refers to accents placed in certain music notes that contribute to the articulation and prosody of a musical phrase in relation to surrounding notes. The term 'agogic' is described in the Oxford English Dictionary (http://www.oed.com) as follows: "Of accentuation: dependent on duration; characterized by a slight lengthening of the time value of notes, a modification of the relative length of a note in relation to its neighbours, or the slight delaying of the placement of a note in performance; of or relating to accentuation of this kind".

tionable whether conductors' gestures are or not 'emblematic', that is: able to convey "one unmistakable meaning that would be understood by a majority of onlookers" (Cofer, 1998: 361). Findings suggest that age and musical skill level of the observer are relevant factors in attributing meaning to conductors' gestures, and although gestures performed by conductors encompass emblematic gestures that can be understood by people in general, they also perform other gestures whose meaning is not readily or easily decoded (Sousa, 1988; Taylor, 1989; Cofer, 1998).

Studies of an experimental nature focused essentially on the effects of not only expressive gesture effects (Skadsen, 1997), but also temporal conducting gestures. Temporal conducting gestures are usually performed with the right hand and intended to provide the beat, and are intended for temporal coordination and synchronisation across a group of performing musicians. Such studies include Kelly's (1997) investigation into the effects of these gestures in participant education and motion-capture studies (e.g. Clayton, 1986; Luck & Nte, 2008). Luck & Nte (2008) demonstrate that there is a significant effect of participants' previous musical experience on their ability to synchronise with a gesturing conductor, suggesting that rhythmical entrainment, despite appealing to basic human perceptual processes (Luck, 2000), is also a process that benefits from exposure and development. In a mixed method study Parton and Edwards (2009), using naturally occurring video recorded data of conducting classes, found a systematic relationship between conductor gesture and the behavioural responses of musicians being conducted. Another recent study (Wöllner, 2012), looking at how conductors perceive and distinguish their own gestures from other conductors' gestures of thirteen orchestral conductors in visual, auditory, and audiovisual displays, revealed that self-recognition was more accurate in conditions presenting highly skilled conducting movements. This suggests an influence of dynamical characteristics of motor skill on action-representations and self-other identification. Recent technological developments have led to possibilities of analysing participants' interaction with simulated conductor gestures mediated by technologies[21] (e.g. Kabisch, Williams & Dourish, 2005; Lee, Wolf & Borchers, 2005).

To sum up, over the past twenty years the study of conductors' gestures has yielded relevant insights into parallels of such gestures and co-verbal gestures; effects of conductors' expressive gestures in performing musicians, music being performed and observers in general; and temporal aspects allied to musical and communicational synchronisation. Nevertheless, it becomes apparent that more research efforts need to be devoted to understanding teaching and learning processes in the art of conducting and to interrogate pedagogical and musical considerations that can from here, be extended to other musical arenas, particularly into the teaching of music and musical instruments.

2.2.2. Music performance

Interest among musicians, music researchers, and the wider research community about the topic of gestures in music performance has been gradually fuelled in recent times. The motor of interesting discussions (see Cadoz and Wanderley, 2000; Leman & Godoy, 2010) has centred upon the confusion between gesture definition and body movement, the problems of reducing gestures to body movement (see Leman & Godoy, 2010), and musical gesture classification. The variety of interpretations surrounding the meaningfulness and functionality of body movements and gestures as used in musical performance stems from the fact that gestures in musical

[21] For a review on such technologies see Johannsen & Nakra, 2010.

performance are involved at multiple levels of communication, not just that of sound production. Gestures form part of communicating musical expression, facilitating technical movements for playing or singing, regulating temporal aspects of musical performance, and providing cues (of musical or social nature) to co-performers, audiences and others (King & Ginsborg, 2011). Recent research can also be distinguished in relation to solo musicians – such as singers (e.g. Davidson, 2005; Ginsborg, 2009), pianists (e.g. Clarke & Davidson, 1998; Davidson, 1994; King, 2006), violinists (e. g. Davidson 1993, 1994), clarinettists (e.g. Rodger, Craig & O'Modhrain, 2012; Wanderley & Vines, 2006), and ensemble performances (e.g. Davidson, 2005; Keller, 2008; Maduell & Wing, 2007; Williamon & Davidson, 2002). Although some of this work has been carried out in contexts other than the western classical musical tradition, such as jazz, popular music and Indian music, there is a still disproportionate level of attention given to the western classical tradition, and almost exclusive focus given to expert performers.

Obstacles along the way in establishing gesture studies in the field of musical performance were essentially of a terminological and methodological nature. Firstly, is has been difficult to distinguish between gesture and body movements (see Cadoz & Wanderley, 2000; Leman & Godoy, 2010). In some cases authors prefer to focus on body movement instead of gesture, arguing that action is generated before sound and can better describe coherent and goal-directed movements, such as musical performance related movements (e.g. Haga, 2008; Jensenius, 2007). Yet such views overlook ways in which performers' mental representations[22] of sound determine the type of physical actions they produce in musical performance (Chaffin, Imreh &

[22] Musicians mental representations can be: 'visual, auditory, kinaesthetic and/or analytic… and enable musicians to give performances that are stable, insofar as repeated rendentions of the same work [that] can be said to be the same, and flexible' (Ginsborg, 2009: 121). Chaffin, Imreh and Crawford (2002) described how mental representations are developed for a specific piece of music and intrinsically dependent on the way that musicians carry out their practice and rehearsals.

Crawford, 2002; Davidson, 2005; Ginsborg, Chaffin & Nicholson, 2006; Ginsborg & King, 2007; Ginsborg, 2004). As such, the question of 'what precedes what' requires more careful consideration. Secondly, the multifunctional character of gestures in musical performance in which technical, expressive and communicative roles (Delalande, 1988; King & Ginsborg, 2011) act and interact simultaneously (and are difficult to disentangle), led to specific gestural categorisations with divergent foci of attention – as further explained in chapter 3. Different methods have been used to study gestures in this context, ranging from systematic observations of video material consisting mostly of performances, rehearsals and improvisation material (e.g. Ginsborg, 2009; King, 2006; Williamon & Davidson), to the use of tools and processes such as motion capture to obtain parameters such as 'gesture amplitude', 'speed' and 'plane of direction' (e.g. Clarke & Davidson, 1998; Wanderley & Vines, 2006). The material in analysis has essentially been: types of physical gestures (such as head nods, body sways, hand lifts, wrist rotation); other non-verbal behaviours, such as facial expressions and eye contact; the relationship between musical structural parameters and observed gestures; the functions of gestures (such as communicative, technical); and examinations on the effect of gestures at various levels, such as musical and social (King & Ginsborg, 2011).

The findings of this growing body of literature essentially suggest that gestures in music performance can emphasise musical structure (Chaffin & Logan, 2006; Davidson, 2006; Elsdon, 2006; Williamon & Davidson, 2002), and there may be a gestural repertoire associated with particular moods or instructions given to the performer – thereby establishing and facilitating musical communication during performance (Chaffin & Login, 2006; Davidson 2006, 2007; Elsdon, 2006). Even ancillary gestures (those that do not produce sounds but can express musical intention, structure, and emotion) have recently been appointed as key ingredients in the perception of musical skill (Rodger, Craig & O'Modhrain, 2012). Communication through bodily dialogue adds another layer of understanding to the musical performance, both to performers, co-performers and audiences alike; central to the field of singing and gesture is the conviction that the singer's coordination and song narrative expression relies upon non-verbal codes tantamount to those used in speech – gestures are used to enable and facilitate communication between co-performers and audience (Davidson, 2005). Moreover, that the use of non-verbal communication contributes to the establishment of a sense of identification, in which individuals understand their status and specialised roles while contributing to effective management of the musical performance (Clayton, 2005). This enforces the notion that gesture and sound are parallel channels for expression of the melody (Rahaim, 2008). Evidently, some gestures in musical performance are solely intended for visual communication while other communicative gestures interact and overlap with the functional aspects of sound producing (Dahl et al., 2010). And there are individual, musical and social factors influencing gestural and body movement in musical performance: gesture used in musical performance can be idiosyncratic – that is, specific to the individual – reflecting aspects such as a performer's emotion and individual gesturing style. They are also musical – stemming from specific musical intentions dictated by the musical material and evidently bound to social norms of human communication and the ritual of performance (Rahaim, 2012).

Added to this, individual, musical, and social factors not only influence gestural production, but also influence gestural perception. Factors relating to the perceiver, such as their: cultural and social knowledge; beliefs and mood at the time of the performance; the environment in which it takes place; and their auditory (as well as visual) perception of the music, all interact with each other, contributing to the meanings attributed to specific gestures (King & Ginsborg, 2011). Research findings born from the simultaneous consideration of gestures and musical performance (Clayton 2005; Davidson, 2005; Poggi, 2007, 2011) laud the importance of gestures in co-performer and audience communication, emphasising the multimodal character of gestures in musical communication (Haviland, 2007). However, despite acknowledging the influence of social and cultural factors in musical performance there has been so far a tendency for considering musical performance as a 'final construct' in analysing movements/gestures, rather than as an on-going process rooted in educational practices.

2.2.3 Music education

Despite the relatively recent recognition of the roles of gesture in music performance, consideration on the importance of gesture and body movement in the context of music education emerged much earlier, in the 19th century, most particularly (anecdotally) in the work of Dalcroze (1865-1950), Orff (1895-1982) and Kodály (1882-1967). These pedagogues established different methods and approaches for including gesture and body movement into music education, with varying levels of importance ascribed to gestural and movement components. Of the three, Dalcroze is undoubtedly the most influential, posing the idea that teachers' neglect of bodily considerations in the teaching and learning process were the reason why early 20th century conservatoire training was failing to instil musical expressivity and accurate rhythmical perception in learners (Seitz, 2005). His views, that "musical expressivity is embodied – that is, resides in the physical characteristics of the body – and entails physical and social interaction with others" (Seitz, 2005:420) paved the way for recent empirical findings focused upon gesture in musical performance, as discussed during the previous section (2.2.2). The way that Dalcroze emphasised the body as the primary source of knowing, in a world still heavily influenced by a long philosophical tradition of consciousness as the source of knowledge (e.g. Descartes), is remarkable. It was only slightly later that the influential philosopher Merleau-Ponty (1908-1961) maintained that the *body* and *what it perceives* cannot be disentangled, essentially forming the basis of embodiment theory[23]. In addition, Dalcroze's belief that instrumental music technique should be taught only as a means to artistic expression and not as a means in itself chimes with the piano pedagogical and philosophical principles set by his great contemporary, Neuhaus (1888-1964). Tone and rhythm, the essential ingredients of the Dalcrozian teaching and learning method (entitled 'Eurhythmics'), are to be learned through bodily movement in 'whole gesture songs' – intended to train the body to simultaneously internalise and respond to music (Dalcroze, 1921). Despite the relevance of such assumptions, it was only in 1997 that Dalcroze's views on the importance of movement in music education were approached empirically, in a study on the musical creativity of young children in nursery setting that produced striking findings (Cohen, 1997): cognition has its roots in kinaesthetic gestures that powerfully affect musical teaching and learning because they act as a pedagogic tool capable of transforming the mind's musical developmental process. Roughly a decade later, Overy and Molnar-Szakacs (2009: 486) proposed that "music is perceived not only as an auditory signal, but also as intentional, hierarchically organized sequences of expressive motor acts behind the signal".

[23] Although a disembodied approach still dominates much of the scene in the cognitive sciences, psychology and neurosciences, modest advancements towards empirical considerations on embodiment theory have nevertheless started to take shape since the 1980s.

Strongly influenced by mirror neuron research[24] (e.g. Kohler. et al., 2002; Rizzolatti & Arbib, 1998; Rizzolatti & Craighero, 2004), these authors claimed that the mirror neuron system is at the centre of the musical experience allowing for "co-representation and sharing of a musical experience between agent and listener" (*ibid.*). The problem of such an assumption is that to date there remains uncertainty and controversy regarding the role of mirror neurons roles in cognitive functions (see Heyes, 2010; Hickok, 2009) (for more on this controversy see Sections 6.1.1. and 6.1.2.).

Dalcroze's method (1930) has influenced Carl Orff's Schulwerk pedagogy, which consists of fundamental guiding principles for teachers with no systematic stepwise procedure to be followed. The basic pillars of the approach are to teach music and movement 'by doing' in a child-centered environment (Saliba, 1991) in which the percussive rhythm is considered as a basic and natural form of human expression. The driving idea behind Orff's work was to provide opportunities for children to experience art, music and movement in the *Güntherschule* in Munich, an educational centre for music, gymnastics, dance and rhythmic movement. The approach incorporates familiar, easily grasped tunes and a rather improvisational approach[25]. In contrast to both Dalcroze and Orff, however, is Kodály (1965) who adapted the hand signs devised by Curwen's (1816-1880) 'Tonic Sol-fa' system to

[24] The discovery of mirror neurons in the brains of primates that fire not only when an action is executed but also when that same action is observed or heard led to proposals of a homologous system in humans (see Rizzolatti, Fogassi & Gallese, 2001). However, there remains much speculation and disagreement amongst the scientific community regarding how mirror neurons might support cognitive functions, particularly imitation. In addition, several neuroscientist question the evidence put forward regarding the roles of mirror neurons (see Catmur, Walsh & Heyes, 2009; Heyes, 2010; Hickok, 2009).

[25] For more on Carl Orff's pedagogical approach see his five-volume series entitled *Music for Children*, published in 1950.

denote grades of scales (Stevens, 2008), using gesture as an aid to the learning process rather than as an integral and central aspect for learning[26].

In recent years, growing empirical evidence has gathered momentum pertaining to the benefits of movement and music for child-development (Cohen, 1997; Ferguson, 2005). And this has been advanced from disciplines such as psycholinguistics, which assert that gesture can assist in learning a range of other subjects, such as mathematics and languages (Cook, Duffy & Fenn, 2013; Cook, Mitchell & Goldin-Meadow, 2008; Cook, Yip & Goldin-Meadow, 2010; Cook & Goldin-Meadow, 2006; Sassenberg, 2011). However, while there are references in the literature to aspects relating to sensory and motor development, there remains a need for systematic consideration of the perception and cognition of movement in the gestural processes of teaching/learning music.

2.2.4 Instrumental and vocal music education

Despite Dalcroze's assertions regarding teacher neglect of bodily considerations in instrumental music teaching and learning, it took a century for research considerations to start to emerge in the singing context and in relation to other musical instruments. Generally speaking, the context of instrumental music teaching has been given little research attention and, historically, literature that examines the use of the body in instrumental teaching and learning[27] relies mostly upon subjective and vague perceptions of what works in the personal experience of music teachers and other pedagogues, rather than upon an accurate and systematic understanding of both: 1)

[26] In fact, systems of hand gestures to aid learning of musical material were used since ancient times, as part of the Coptic, Byzantine, Jewish liturgical chant practices and Gregorian chant (Rahaim, 2012).

[27] Examples of such literature are given on footnote 14, page 31.

the power of non-verbal communication in the music instrumental pedagogical setting (Kurkul, 2007); and 2) the biomechanical principles of human movement required to safely teach and learn playing a musical instrument (Brandfonbrener, 2003; Visentin, Shan & Wasiak, 2008).

The close interplay between singing and speech in which gesture is saliently 'seen' as a shared communicational channel aiding meaning to both singing and speech (even when singing without words), albeit with added technical functions for singing, might explain why gesture in vocal pedagogy was noted first by researchers. Considerations first emerged in the choral environment where gesture is considered an important music learning element. Wis (1993) attempted to establish a theoretical framework for considering gestures used in day-to-day life as an adjunct to expressing musical and vocal concepts. The use of movement and gesture in choral singing has been evidenced to improve aspects such as tempo, articulation, tone, singing posture and intonation (Bailey, 2007; Chagnon, 2001; Crosby, 2008; Hibbard, 1994). However, specific empirical considerations, considering gesture as an integral and essential element in the singing pedagogical process have only recently emerged.

Nafisi's (2013) recent PhD thesis, (Monash University, Australia) entitled *Gesture and body-movement as teaching and learning tools in western classical singing*, using survey and experimental approaches, mostly serves to confirm that singing teachers frequently use movement and gesture in their teaching practices. Her proposed classification of singing teachers' gestures is (terminologically speaking) ambiguous, as can be noted on the names given to gesture categories: 'Physiological' (gestures that aid visualising internal physiological mechanisms in the singing process); 'Sensation related' (serve the purpose of illustrating singing metaphors, imagery and/or acoustic phenomena without reflecting actual physiological occurrences); ‘Musical’ (hand gestures that give a visible form to musical phenomena and include gestures such as conducting gestures, a hand describing a ‘legato’ sign, beats to emphasise the tempo or pace of the music); ‘Body movement’ (movements encouraged by voice teachers such as walking, swinging of arms or lying on the ground distinguished from gestures on the grounds of not having intentional expressive component).

There are a number of constraints with this work. To begin with, there is an assumption that teachers gesture consciously and intentionally (see Nafisi, 2013) and such assumption is in stark contrast to relevant findings in gesture led research in fields such as psycholinguists, neuroscience, motor learning and even music (e.g. Cook & Tanenhaus, 2009; Goldin-Meadow, 2003; Hatten, 2006; Magill, 2007). This is to say that even if a teacher performs gestures with a certain pedagogical intent, it cannot be assumed that the actual performance of the gesture is processed at a conscious level, nor that the focus of attention of the teacher at that moment is on the performed gesture. Further, the devised classification system remains incomplete given that it only considers gestures associated with the singing process, ignoring other communicative instances that may occur between teacher and student, which are nevertheless essential in the pedagogical process as a whole. Additionally, there is a lack of specificity in the terms given to gesture types: the author dissociates gestures associated with physiological visualisations intended at musical production and essential for the process of singing, from the musical gestures in itself, when it appears that such physiological gestures have (at the very least) deep musical intentions and practical musical applications. Besides from encompassing what can be considered ‘metaphoric’ and ‘iconic gestures’ (McNeill, 1992), the gesture category ‘Sensation related’ seems to imply that there are sensations and emotions associated with these gestures, which, of course, could well be the case. However, the author did not assess this element at an empirical level. And through this exclusion, the project ignores other sensations that could occur during other gesturing instances, and alongside the embodied and deeply kinaesthetic experience of making music – occurring with other gesture categories. A similar problem emerges in relation to the author's claims that teacher gestural performance has an effect on student learning. Here the method used does not agree with the educational premises of effectively studying student learning outcomes, in which it is essential to evaluate retention and transfer of learning (see Magill, 2007). Finally, the survey methodology (a questionnaire completed by singing teachers relating to the nature and types of gestures they perform while teaching), does not warrant enough basis for empirical considerations.

A landmark on gesture and body movement in the vocal music teaching and learning context (albeit not within the western classic musical context) is Rahaim's (2012) ethnographic observations of the teaching and learning of singing in Hindustani music. His observations led him to add another dimension or layer to the term 'musicking'[28], firstly proposed by Christopher Small (1998). Rahaim (2012: 2) adopts the term 'musicking body' in reference to "a trained body in action, engaged mindfully in singing and/or playing an instrument (…) whether alone, in teaching, or in concert, with a special focus on the bodily action this involves". Such recognition of the role of the body in instrumental music teaching marks a shift towards a pedagogy of embodiment in the instrumental music teaching context, that despite occurring in each and every teaching act, has so far, mostly been excluded from empirical considerations. Resemblance of students' gestures with those of their teachers has in

[28] As initially proposed by Christopher Small (1998), the term 'musicking' served the purpose of expanding the notion of musical experience, previously heavily focused on musical performance towards musical experiences outside performance boundaries in order to include attending concerts and listening to music.

fact been noted by Rahaim (2012) and informally in the context of western classical music: "Anecdotally I have been able to identify the students of my colleagues by the way not only how they hold their instruments, but by the expressive gestures employed" (Davidson, 2012: 774). Thus, such resemblance should be more deeply considered through academic research.

Elsewhere it is suggested that student-teacher interaction is a crucial factor in determining the level of skill the student is able to attain (Howe & Sloboda, 1991; Manturzewska, 1990; Sosniak, 1990); thus if teachers' gestures have a role to play in teacher-student interaction, then gesture could potentially, directly impact upon student skill levels. Gesture can also help in solving the documented divided opinions that instrumental music teachers have regarding learning music expressivity (Karlsson & Juslin, 2008) – some teachers acknowledge the ability to communicate expressively in music as a talent that cannot be learned, while others argue that expressive skills can benefit from instruction, and attempt to explore effective ways of teaching expressivity (Sloboda, 1996). Overall from this discussion it can be concluded that gesture is a ubiquitous communicative channel, and in musical communication it is in need of exploration that can provide innovative pathways for music teaching at all levels.

2.3 Gesture in other landscapes

The shift towards what we now consider as the 'modern field of gesture studies' was given through the seminal works of David Efron (1941, 1972), McNeill (1979, 1981), and Kendon (1972, 1980), who paved the way not only for gesture studies in human interaction, but also established the premises that would enable the establishment of empirical and systematic gesture research. This turning point owes to developments in psycholinguistics that have questioned the traditional view of communication as divided into verbal and non-verbal components, leading to claims that gesture and speech are part of an integrated communicative system. This idea, initially put forward by McNeill (1992) was built upon Kendon's (1980) considerations that gesture and speech are integral elements of conversation that cannot be dissociated; and it is supported today by findings from varied research disciplines in which gesture studies have carved niches: psycholinguistics, psychology, neuroscience, robotics, anthropology and semiotics[29].

Over the past two decades, a great deal of research has been dedicated to one fundamental question: are spontaneous co-verbal gestures intended for communicative purposes? Although communication is a dynamic interactional process, answering this question empirically requires separate and independent attention given to speaker and addressee (Melinger & Levelt, 2004). On the one hand, in some studies listeners' comprehension of speech did not appear to be influenced or enhanced by the presence of gestures (Feyereisen, van de Wiele & Dubois, 1988; Krauss, Dushay, Chen & Rauscher, 1995; Krauss, Morrel-Samuels & Colasante, 1991). On the other, further research findings suggest that listeners attend and incorporate gesturally expressed information into their understanding of a narrative (Beattie & Shovelton, 1999, 2002; Cassell, McNeill & McCullough, 1999; Gullberg, 2003). A significant recent development is that cognitive neuroscience techniques are gradually being incorporated into traditional gesture research, particularly in developmental and educational domains (e.g. Kelly, Manning & Rodak, 2008; Sheehan, Namy & Mills, 2007; Skipper, Goldin-Meadow, Nusbaum & Small, 2007; Williams, Whiten, Suddendorf

[29] The interdisciplinary nature of gesture studies is well asserted at the website of the International Society of Gesture Studies, founded in 2002 and in their Journal called Gesture, currently edited by Adam Kendon. See: http://www.gesturestudies.com/, accessed March 14, 2014.

& Perrett, 2001), and this is likely to shed important insights into the roles and functions of gestures in the near future.

2.3.1 Understanding the integrated view

Claims that gesture and speech operate through separate channels and convey different meanings (see Beattie, 1981; Feyereisen & de Lanoy, 1985, for reviews) are now mostly part of a near historical past as the majority of recent research supports the integrated system view of gesture and speech for language production and comprehension (Kelly et al., 2008). At the heart of the McNeil's integrated account, gestures and speech combine in order to communicate meaning that is not fully expressed in one modality alone. Prior to the communicative act, gesture and speech constitute part of a single idea: the 'growth point' (McNeill, 2005), in which some information is channelled into speech and some into gesture, and both speech and gesture constitute alternate channels for the expression of semantic content.

A substantial number of findings support this integrated view, and these include research topics relating to the close interplay between gesture and speech – where 90% of gestures developed by adult speakers are performed alongside speech (McNeill, 1992). And evidence that gesture and speech are temporally synchronised – linguistic segments and gestures representing the same information, occur simultaneously (see Nobe, 1996, 2000). Such co-temporality was later proven to relate to the degree of familiarity of the spoken word and it continues to exist even when speech production deviates from the intended conversational content (see Mayberry, Jaques & DeDe, 1998). Also, the fact that gesture production is interrupted during stuttering (Mayberry & Jaques, 2000) suggests that gestures have semantic and pragmatic functions as speech that are matched, in time, and are synchronous to the parallel linguistic units. Similarly, children (like adults) also spontaneously produce gestures with their speech, even at the one-word stage of language development – although prior to the development of two-word speech, there is a period in which speech and gesture appear not to form a fully integrated system (Goldin-Meadow, 1999). Nevertheless, gesture and speech coordination and ability to convey and perceive others' gestures and speech develops early, and is retained and continued throughout adult life (Goldin-Meadow, 1999, 2003). The integrated view is also supported by neurological evidence. In Broca's and Wernicke's types of aphasia[30], dissolution in speech also results in gesture dissolution. It has been shown by neuroscientists that certain types of gestures are controlled by the same brain areas that control speech, although it has not yet been possible to precisely point brain areas that control co-verbal gestures (Cook & Tanenhaus, 2009; Pinker, 1994).

Although gesture production is closely synchronized with speech at various levels: structurally (e.g. Kita & Özyürek, 2003), temporally (e.g. Chui, 2005) and semantically (e.g. McNeill, 2005) such 'coordination' does not imply that gestures and speech convey the same information and often they do not: whilst speech communicates in "a segmented, combinatorial format" (Goldin-Meadow, McNeill & Singleton, 1996: 52), gesture communicates "in a global, mimetic format" (*ibid.*). That is to say that speech and gesture lie on different representational and categorical universes: whilst speech conforms to a system of pre-established rules essentially based on morphological (the structure of words) and syntactical rules (how words combine to form sentences) (Brown, 1973); gestures that spontaneously accompany

[30] People suffering from **Broca aphasia** use referential terms and referential gestures, however they lose the ability to combine linguistic units towards grammatical wholes and so their capability of using beat gestures to emphasise interrelations between speech units. **Wernicke's aphasia** patients suffer from language comprehension and struggle with the production of meaningful language. Despite experiencing difficulty in understanding spoken language sufferers of this condition are able to produce sounds, phrases, and word sequences. However, while their utterances have the same rhythm as normal speech, they are nevertheless unable to convey meaningful information.

speech are not dictated by rules, and enable speakers to express ideas that pertain to the representation and communication of aspects related to the description of spatial relationships, shapes, size and action. In this sense, meaning from gestures is identified by globally 'looking' and considering gesture form (in terms of its shape or trajectory in the air) and the context in which it is performed, in addition to the associated speech (see Goldin-Meadow, 2003a).

With regard to gesture shape or form, a gesture evolves through three essential phases: 'preparation', 'stroke' and 'retraction' (Cienki, 2008; Kendon, 1980; McNeill, 1992); however, meaning given to gestures, in relation to the kinetic aspect of gesture, is depicted essentially from the 'stroke' phase, that basically determines what function/s a gesture can assume as a whole (McNeill, 1992). In the phase of 'preparation' "the limb moves to the initial position of the stroke" (Kita, Van Gijn & Van der Hulst, 1997: 26). The 'stroke' consists of the phase in which "the limb makes an 'accented movement' with a distinct peaking of 'effort' ". The expression "peaking of effort" comes in sequence of Rudolf Laban's work, who devised a system for annotating dance movements. He stated: "Since it is absolutely impossible to take account of each infinitesimal part of movement we are obliged to express a multitude of situations by some selected 'peaks' within the trace-form which have a special quality" (Laban, 1966: 28). This idea was transposed from the field of dance to the modern field of gesture studies by McNeill (1992: 376-377) who considered that a gesture 'stroke' consists of "the phase carried out with the quality of 'effort' semantically considered as the "content-bearing part of the gesture". Thus, gesture considerations regarding meaning are essentially focused on the 'stroke' phase for the above reasons. In the 'recovery phase' "the limb moves back to the resting position…[however] [w]hen multiple gesticular phrases are concatenated, the recovery can be cut short and becomes a 'partial retraction' or completely eliminated" (Kita, Gijn & Hulst, 1997: 26). The definition and recognition of these main three phases of a gesture unit, owes much to Laban's work and constitutes to this day the main pillars of modern gestural annotation. In the next sections I will focus (separately) upon what is known today about how gesture functions for speakers, and how addressees derive meaning and information from speakers' gestures.

2.3.2 Gesture for speakers: thinking and communicating

Gesturing serves a number of important functions for speakers: it helps people to retrieve words from memory (Rauscher, Krauss & Chen, 1996); it reduces cognitive burden, enabling allocation of effort to be placed in other tasks (Goldin-Meadow, Nusbaum, Kelly & Wagner, 2001); it provides people with an alternative representational format in addition to speech (Goldin-Meadow, 1999). Gesture has also been shown to be helpful in accessing new thoughts, given that gesture's representational format is mimetic instead of discrete (McNeill, 1992). New ideas are, therefore, more easily conveyed by physical gesticulation than speech (Goldin-Meadow, 1999). Gesture also improves the learning process: children show improved learning in maths counting tasks when required to perform pointing gestures, and teachers' gestures while explaining maths and other subjects were shown to result in improved children's performances in word recall tasks (references). Gesture can also reveal the level of knowledge people have in a particular subject: a study of gestures performed by children (5 to 10 years), as they were asked to describe a board game, has shown that the gestures children employed while talking about the game provided insights about their specific knowledge related to the rules of the game (Evans & Rubin, 1979). So, gestures provide "substantive information" (Goldin-Meadow, 2003a) about speakers' mental representations, and seem to be more "free to assume forms that speech cannot assume" (*ibid.*: 5), displaying thoughts that are not revealed through speech alone, in ways that help speakers and listeners alike to reduce cognitive effort while at the same time being tools for thinking (Goldin-Meadow, 1999). But what are speakers' motivations for gesturing and how and why gesturing results on the above empirical findings? Answers to these question have been sought from various fronts, particularly attending to the integrated relationship of gesture and speech regarding: language production and comprehension; the relation between gestural production and cognitive development; and neuroscience research. This constitutes the material of the next sub-sections.

2.3.2.1 Gesture and speech: integrated for language production

Among the most relevant theories in the present scientific debate about the integrated relationship between gesture and speech is the Growth Point Theory (McNeill, 1992) where gesture and speech relations are approached from a semiotic stance; other theories mostly adopt an information processing approach and the most prominent in the current academic debate are: The Lexical Retrieval Hypothesis (LHR) (Krauss, Chen & Gottesman, 2000), Image Activation Hypothesis (IAH) (de Ruiter, 1998; Freedman, 1977), and Information Packaging Hypothesis (IPH) (Kita, 2000). The main assumption of Growth Point Theory is that gesture and speech production share a common origin: the 'growth point' – which is considered to be the "minimal unit" (an idea taken from Vygotsky, 1987: 4-5) of "imagery language code combination" (McNeill, Duncan, Cole, Gallagher & Bertenthal, 2008: 121). As these authors state: "It is the smallest unit encompassing imagery and linguistic encoding (…) inferred from speech gesture synchrony and expressiveness" (*ibid.*: 121). McNeill (2005 and et al., 2008), elaborating from the ideas of Vygotsky (1987), refers to language as an imagery-language-dialectic, in which gestures provide imagery. He considers gesture as an integral component of language when synchronous and co-expressive with speech, creating the conditions for an imagery–language–dialectic that fuels thinking for speaking as it seeks resolution. The communicative process results from the interplay between imagistic information (provided by gesture) and linguistic utterance (provided by speech).

The Lexical Retrieval Hypothesis (LRH) poses that gesture execution animates active-spatio-dynamic features which in turn, activate conceptual information. Thus gesture precedes speech and is generated through spatial imagery existent in working memory. It is argued that, by a process of cross-modal priming, gesture production help the retrieval of lexical items, thus helping speech production. The Image Activation Hypothesis (IAH) considers that gesture production helps in maintaining an image (Freedman, 1977) or spatial features (de Ruiter, 1998) that are encoded during speech formulation. Substantially differing from LRH and IAH, is the Information Packaging Hypothesis (IPH) where it is suggested that gesture has a role in structuring information and in 'packaging' such information in specific units that can be suitable for speech formulation. As such, gesture is not considered to merely serve functions such as activation or maintenance of information; rather, gestures contribute to the inherent process of structuring information in the brain. Here it is anticipated that gesture is generated through spatio-motoric processing, and speech through analytic processing – in which spatio-motoric thinking aids speaking by granting "an alternative organisation that is not readily accessible to analytic thinking" (Kita, 2000:163). According to this theory, gesture and speech have access to different sets of information that are coordinated during language production, in such a way that they tend to converge.

Both IAH and IPH theories added gestural components to Levelt's (1989) model of speech production. The application of IAH to Levelt's model is known as the Sketch Model (de Ruiter, 2000), and the application of IPH is known as the Interface Model (Kita & Özyürek, 2003). The Sketch Model suggests that gestures are generated from imagistic representations available in working memory, and are produced in three stages: "selection of information that is to be expressed in gesture (the sketch); the generation of a motor program for an overt gesture; the execution of the motor program" (de Ruiter, 2000: 304). The Sketch Model agrees with McNeill that gesture and speech share a common origin, and are semantically synchronous given that they derive from the same communicative intention. However, whilst gestures are derived from imagistic representations, speech derives from propositional representations (de Ruiter, 2000:304). The interface model (Kita & Özyürek, 2003) includes a bidirectional link between gesture and speech, allowing for gesture and speech production to be semantically and structurally coordinated, and to function in a continuous and dynamic way in which both modalities (gesture and speech) excel influence on one another. In this way, this model accounts for findings from several studies focused on motion event descriptions that point to a dynamic link of influence between speech and gesture (e.g. Alibali & Kita, 2010; Alibali, Spencer, Knox & Kita, 2011; Kita & Özyürek, 2003). And although McNeill's (2005; 2008) model emphasises the strong interplay of gesture and speech in terms of what can 'visibly' be perceived, it fails to explain the mechanisms involved in the dynamic interplay, and at this level: the information processing models (explained above) can complement[31] the integrated system proposed by McNeill (1992).

2.3.2.2 Gesture and speech: integrated for language comprehension

Findings suggest that not only do gesture and speech have an integral and integrated relationship for language production (Goldin-Meadow, 2003a; Kita & Özyürek, 2003), but also for language comprehension (Beattie & Shovelton, 1999; Kelly & Church, 1997). Although speech production and comprehension is significantly influenced by gestures that people produce spontaneously while talking, despite the above models it is not yet known the exact extent to which the gesture and speech relationship operates, and how. Links have been shown between language and action areas of the brain (for a review see Willems & Hagoort, 2007), particularly that brain areas related to speech processes also appear to process actions made with the hands while talking (Gallese, Keysers & Rizzolatti, 2004; Puce & Perrett, 2003). Relevant findings are that when there is compromise of parts of the brain that control hand movements, speech comprehension is also affected (Flöel, Ellger, Breitenstein & Knecht, 2003), and that the neural processing of action verbs occurs in the premotor and motor cortices (Tettamantiet al., 2005) – suggesting a link between gesture and speech for language production and comprehension. In addition, a common neural mechanism has been suggested for gesture and speech, given that gestural and spoken information were shown through functional magnetic resonance imaging, to be integrated in the Broca's area in similar ways for sentence comprehension (Willems, Özyürek & Hagoort., 2007). In particular, multimodal integration sites, parts of the

[31] Except for the LRH in which the main clause that gesture precedes speech clashes with the growth point theory's main essence.

mirror neuron system (inferior parietal lobule and premotor cortex), in addition to emotion centres (the cingulate cortex) (Calvert & Thesen, 2004; Wilson, Molnar-Szakacs & Iacoboni, 2008) are called upon in gesturing and perceiving gesture, suggesting that gesture interacts with speech in linguistic, imagistic, motoric and affective ways (Kelly et al., 2008). These studies from cognitive neuroscience complement research from psychology and psycholinguistics in important ways, demonstrating that gesture influences speech processing during language production and comprehension.

2.3.2.3 Understanding cognitive development through the lenses of gesture

Regarding language and cognitive development, there are suggestions that gestures produced by children reveal more about what they are thinking than their speech alone (Alibali, 1999; Church, Schonert-Reichl, Goodman, Kelly & Ayman-Nolley, 1995; Goldin-Meadow, 2000). Church and Goldin-Meadow (1986) found that iconic gestures performed by children while giving explanations conveyed different information than the spoken utterances. Based on the fact that gestures occur in sequence of a topic introduced by speech, and also introduce new information that is not provided by speech, Church and Goldin-Meadow (1986) analysed the relationship between gestures and speech in relation to the extent to which they overlap, regarding the information being provided. They posit the terms ‘gesture-speech-matches’ for cases where gesture and speech provide overlapping information and ‘gesture-speech-mismatches’[32] for cases in which they do not provide overlapping infor-

[32] Although the word **‘mismatch’** may implicitly convey an idea of ‘conflicting or contradictory’ information the authors clearly state that they do not wish to introduce such element and argue that in gesture and speech, mismatches do not need to conflict and that rarely they do so (Goldin-Meadow, 2003).

mation, and so the speaker conveys two distinct ideas about the same topic. The study of gesture-speech-mismatches has provided relevant insights for child development and teaching and learning. It is, therefore, suggested that children who present gesture-speech mismatches when solving mathematical problems simultaneously activate two solutions for the same problem, and that this evidences learners' learning transactions in relation to a given task (Goldin-Meadow, 1999; 2003). This led researchers to conclude that children who perform gesture-speech-mismatches are in a "state of cognitive instability"– at "risk for learning and regression" (Goldin-Meadow, 1999: 424) and hence requiring specific and tailored instructions. In another study, Alibali and Goldin-Meadow (1993) established that almost all of the children participating in the investigation passed by two or three of the following steps in order: "1. A stable state in which the child produced gesture-speech matches conveying incorrect procedures; 2. An unstable state in which the child produced gesture-speech-mismatches; and 3. A stable state in which the child again produced gesture-speech-matches, now conveying correct procedures" (in Goldin-Meadow, 1999: 424-425). Mismatches provide relevant insights into the cognitive state of speakers by evidencing readiness for cognitive growth. These findings led to the conclusion that although it is not clear whether mismatches form part of the growth transition, they certainly provide important insights for teachers and educators alike – in teaching and learning settings and also in clinical environments.

Gesture can also predict developmental delays (Mitchell et al., 2006; Smith, Mirenda & Zaidman-Zait, 2007): deficits in gesture production have been shown to correlate with language and cognition deficits (Charman, Drew, Baird & Baird, 2003; Thal & Bates, 1988). Despite gesture being quite often impaired in individuals with developmental disorders, evidence suggests that gesture can at times compensate for cognitive and language delays or deficits. Children with Down's Syndrome tend, for instance, to gesture more than typically developing children (Caselli et al., 1998), suggesting that gesture in these cases may be used to 'make up' for language production and comprehension deficits (Stefanini, Caselli & Volterra, 2007). Being helpful in the identification of developmental delays, gestures are also helpful for early interventions. High levels of parent gestural responsiveness to their children with language delays were associated with improved scores in expressive and receptive language (Brady, Marquis, Fleming & McLean, 2004), leading to the importance of instructing parents to attend to children gestures (see Calculator, 2002).

2.3.3 Gesture for addressees

Whilst it is well established that gesture serves a number of important cognitive and communicative functions for speakers, the question of whether gestures communicate to addressees has been quite controversial. Nevertheless, evidence around the ways in which addressees process gesture information is increasing, particularly in regards to representational gestures (iconically represent aspects such as shape or direction) (see Cassell et al., 1999; McNeill, Cassell & McCullough, 1994): Firstly, it is widely understood that speakers often express information in their gestures that is not conveyed in their speech alone (Church & Goldin-Meadow, 1986; Perry, Church & Goldin-Meadow, 1988; Pine, Lufkin & Messer, 2004). Secondly, observers have been shown to understand and use this information, usually without being consciously aware (Goldin-Meadow & Sandhofer, 1999; McNeill et al., 1994). And thirdly, even children at the early stages of language learning (Kelly, 2001; Morford & Goldin-Meadow, 1992) are able to efficiently extract information from a speaker's gestures. Such findings are suggestive of the importance that gesture can assume in pedagogical contexts - not only in helping teachers to convey the content to be learnt but also the influence that teachers' gestures can have on students' ability to grasp and extract information about the learning material.

To cite an obvious example, aspects such as the size and positions of objects are better understood when gestures form part of the conversation (Beattie & Shovelton, 1999). Moreover, indirect requests are interpreted by addressees more accurately in the presence of gestures (Kelly, Barr, Church & Lynch, 1999). It has also been suggested that addressees can "reliably read gesture" (Goldin-Meadow, 1999: 425) when it conveys different information than the one expressed through speech. Goldin-Meadow (1999) described how an adult listening to a child, who is describing how he/she aligned a number of toys, could grasp the meaning of the child's gestures that were not conveyed using speech. Goldin-Meadow (1999) concluded that listeners can extract meaning from gestures that were within a speakers' mind. Overall, this evidence suggests that gesture and speech can together coherently communicate information to listeners, rather than in isolation (Alibali, Flevares & Goldin-Meadow, 1997; Goldin-Meadow, Wein & Chang, 1992; McNeill et al., 1994). There is also evidence that gesture impacts addressees' behaviours. Addressees not only attend to speakers' gestures, but also modify their understanding of spoken utterances accordingly (Kendon, 1994), and alter their behaviour in line with the information perceived (Goldin-Meadow, 1999). However, when conveying messages different from the one in speech, gesture also has the potential to prevent listeners from understanding the information as well (*ibid.*).

Neuroscience research using brain imaging techniques such as Electroencephalography (EEG), Magnetoencephalography (MEG), Positron Emission Tomography (PET), Functional Magnetic Resonance Imaging (FMRI) highlights noteworthy aspects concerning the ways in which gestural information is processed. In observing co-speech gestures, addressee motor systems interact with language comprehension areas to determine the meaning of those gestures (Skipper, Goldin-Meadow, Nusbaum & Small, 2009). It is also suggested that rather than being fixed, the cortical networks underlying language comprehension are organized dynamically, according to the type of contextual information available to listeners during face-to-face communication (*ibid.*). These findings are in line with the interface model (Kita & Özyürek, 2003) (described in the previous section) which included a bidirectional link to suggest that gesture and speech exert a dynamic influence on one another. Thus, it can be argued that addressees' motor systems appear to activate when observing a speaker's gestures, and this impacts upon their ability to use the information conveyed through physical gesticulation (Ping, Goldin-Meadow & Beilock, 2013).

In addition, a study carried out by Cook and Tanenhaus (2009) revealed that gestures are also a reliable source of perceptual-motor information in human communication. In this particular investigation, after solving a Tower of Hanoi task (with either real objects or on a computer), speakers were asked to explain the task to listeners. The results have shown that speakers' hand gestures, but not their speech, evidenced properties of the particular objects and the actions that they had previously used to solve the task. As reported by Cook and Tanenhaus (2009) speakers who solved the problem with real objects used more grasping hand shapes and produced more curved trajectories during their explanation. Listeners, who observed explanations from speakers who had previously solved the problem with real objects, subsequently treated the virtual computer objects in a more realistic way. Thus speakers' procedural information taken from gesture became incorporated into listeners' subsequent behaviour, revealing that listeners are able to extract fine perceptual-motor information from gesture in day-to-day communication. This is a relevant finding given that although it had been suggested that gestures arise from perceptual and motor simulations during communication (Alibali, Kita & Young, 2000; Hostetter & Alibali, 2008; McNeill, 1992; Streeck, 2006), it was still to be known if speakers could provide reliable perceptual-motor information to addressees, particularly in the absence of physical objects (referred to in the conversation) in the immediate environment. In fact, people are subjected to a variety of information that does not easily lend itself to appropriate representation through verbal language, such as information relating to performance actions such as riding a bicycle, or teaching and learning to play a musical instrument. Thus gestures may be a particularly relevant and well suited communicational element for representing information regarding performing actions, given that this sort of procedural knowledge is often not linguistically accessible (Willingham, Nissen & Bullemer, 1989).

One of the difficulties in studying how addressees derive meaning from gesture resides in the essentially visual character of gestural information. This visual nature calls for considerations on the perception of simultaneous visual information, which arises from different sources and competes for attentional resources (that is, cross-modal information processing). Gestures can compete for attention with a multiplicity of factors, such as the speaker's facial movements, expression, animation; auditory factors (such as speech); tactile factors not to mention, environmental factors such as amount of light in the scene, competing sounds/noises, etc. (e.g. Thompson, Malmberg, Goodell & Boring, 2004; Vatikiotis-Bateson, Eigsti, Yano & Munhall, 1998). Whilst gesture motion can potentially contribute to gestures being a prime target of selective visual attention (Wolfe, 1998; Yantis, 1998), it is also possible that gestures are competing with the face, for speech-related information, social interactional norms of human behaviour (see Fehr & Exline, 1987). Elsewhere it has been suggested that people tend to look more often at a speaker's face (Bavelas, Coates & Johnson, 2002), and that this is due to social and cultural norms of eye contact in face-to-face interaction intended at signalling attention and engagement (Goodwin, 1981; Kendon, 1980; Kleinke, 1986). Interestingly, however, cross-modal interference has been shown not only to affect the perception of gestural information, but also the perception of spoken information (Langton, & Bruce, 2000; Langton, O'Malley & Bruce, 1996) itself. The fact is that despite a widespread interest in the visual perception of hands, gestures, signs of sign language, gaze in interaction (e.g. Decety, 1999; Kendon, 1980; Kleinke, 1986; David McNeill, 1987; Streeck & Knapp, 1992; Streeck, 1993, 1994) little is known about the level of attention given to gestures in human interaction (in a context of competing attention) and how gestural information becomes integrated into representations of meaning.

2.4 Summary and new directions in the piano teaching and learning landscape

This chapter's literature review and associated discussions provide a number of relevant insights that have heightened the need for an understanding of teachers' gestures in the mediation of knowledge in the instrumental music pedagogical scenario and educational contexts in general. My considerations of bringing gesture in piano teaching into focus (section 2.1) led to the conclusion that piano teaching (and instrumental music teaching in general) is a process involving three overlapping, hybrid dimensions: social, communicative and embodied processes. Embodiment is not only reflected in the nature of the social and communicative interactions that take place in this context, but is also intimately related to teaching and learning the musical material. Assuredly, gesture and music are two inseparable and integral aspects of the content to be taught and learned in this pedagogical context. This linked with the evident importance of teachers for students' learning success or failure, raises questions about the role of teachers' gestural behaviours in terms of students learning efficiencies; such questions open the door to identifying whether teachers' gestural behaviours could possibly be optimised and geared towards more efficient student learning. It is evident, therefore, that the endeavours of addressing this question, coupled with understanding the role of teachers' gestures, cannot be efficiently achieved through the current focus upon verbal communication channels within instrumental music teaching and learning literature. Moreover, the inadequate attention given to the roles of gestural communicational channels in the instrumental music teaching context is in stark contrast with the level of attention so far spared for gestures in other musical environments – particularly regarding musical performance environments (section 2.2). On the one hand, the findings and research directions taken in these contexts can provide substantial help in conceptualising investigations in the instrumental context; but on the other, the importance of understanding gestures in 'contextualised' environments implies that the translation of findings from other disciplines needs, nevertheless, to be grounded in empirical investigation.

Beyond this, gesture studies undertaken in a multiplicity of fields and varied research settings (section 2.3) demonstrate that co-verbal gestures are not only intended for communicative purposes by speakers, but also that addressees perceive and use this information frequently and without being consciously aware. Given the importance of gesture across different musical scenes and other fields of knowledge, it is imperative to investigate the role of physical gesture in the piano teaching and learning context. While doing so it is relevant to consider gesture as an integral aspect of human to human communication in general, and further than this: its role in the specific processes of musical communication in which musical-knowledge and meaning are created. Indeed, if gestural aspects correlate with teaching efficiency in other teaching contexts (as seen in section 2.1.1), it seems pertinent to ask if there are gestural specificities in terms of piano teachers' gestural behaviour in relation to students' skill levels. And in attempting to answer this, it seems worthwhile to extend analysis to the direct implications and outcomes of teachers' gestural behaviours for student learning. These questions are at the centre of the empirical investigations documented in Chapters 3, 4 and 5.

The research framework followed for investigating the above research questions traces the principles of gestural analysis advocated by the field of psycholinguistics – in which meaning attributed to spontaneous co-verbal gestures is derived from a combination of elements that convey different 'pieces' of information. Thus, meaning from gestures can be derived from the forms that gestures assume in the air, to associated speech, and gestural contextual aspects deemed relevant (Kendon, 2004; Goldin-Meadow, 2003; McNeill 1992; 2005). The context and associated speech are important variables in ascribing meaning to co-speech gesture. Thus, besides looking at the motor behaviour performed during gesturing, in terms of gestural forms and shapes, researchers contextualise gesture meaning by taking into account the co-occurring speech and the task speakers are involved in while talking (Goldin-Meadow, 2003). Now gesturing forward, the empirical work initiated in the next chapter establishes the grounds for researching gesture in piano teaching and learning, by focusing on the establishment of an appropriate gesture categorisation specific to this context, from which this and further work can effectively depart.

Chapter 3
Categorisations of physical gestures in piano teaching

This empirical chapter's aims are threefold. It seeks firstly to identify gestures developed by teachers during the teaching process. Secondly, it tests the adequacy of McNeill's classification of spontaneous co-verbal gestures (1992, 2005) and Jensenius, Wanderley, Godoy and Leman's (2010) functional musical gestures classification, while identifying and describing particular gestures where these classifications may require adaptation or new categorisation. And thirdly, the chapter describes and analyses gestures developed by teachers in relation to specific teaching behaviours, determining whether or not there is a relationship between didactic intentions and types of gestures used to communicate musical knowledge to students. Carried out for the purposes of this thesis and published in the Journal *Psychology of Music* (Simones, Schroeder & Rodger, 2013), this investigation begins with literature considerations about physical gesture categorisations in the field of music performance (Section 3.1), and follows an overview of the field of psycholinguistics regarding categorisations of spontaneous co-verbal gestures (Section 3.1.1). Given that co-verbal gestures are synchronous with speech, they assume particular importance in verbally communicative educational contexts such as the one under scrutiny here. Thus, I examine relevant gesture literature to establish parallels between gesture, music, and speech (3.1.2) and teachers' teaching behaviours, allowing me to conclude the importance of studying this process as a context-dependent ground in which gestures can be examined (3.1.3). The empirical study (Section 3.2) explores the role of gesture within teacher-student communicative interaction in one-to-one piano lessons where three teachers were required to teach a pre-selected repertoire of two contrasting pieces. They did so to three students who were studying piano at grade 1, according to the standard of the Associated Board of the Royal Schools of Music (ABRSM) (see appendix A for ABRSM minimum skill requirements for piano grade 1, in 2011-2014 period). The data was collected by video recordings of piano lessons, and analysed using qualitative and quantitative methods. Spontaneous co-musical gestures were observed in the process of piano tuition emerging with similar general communicative purposes to that of spontaneous co-verbal gestures, and were found to be essential for the process of musical communication between teachers and students. Parallels established between co-verbal and co-musical spontaneous gestures led to an argument for the extension of McNeill's (2005) ideas of imagery-language-dialectic to imagery-music-dialectic with relevant implications for piano pedagogy and fields of study invested in musical communication.

There are several important areas where this study makes a unique and original contribution. The research framework devised here, alongside the categorisation of piano teachers' gestures, can promote further research into the uncharted territory of not only piano but also other forms of instrumental music teaching. Indeed, identifying and categorising teachers' gestures can, not only help teachers' in the essential process of reflecting on their own teaching practice but also contribute for grasping deeper pedagogical insights about the efficiency of particular gestures in the processes of teaching and learning. Furthermore, the concise framework of teaching behaviours established here, variously adopted and adapted from previous researchers can be used for further investigations into teaching processes. With respect to psycholinguistics, the findings of this study challenge the core idea that spontaneous hand gesticulations occur only side-by-side with speech. Thus, the notion that spontaneous gestures (not necessarily co-verbal) co-occur with the pedagogical process of music making and have forms/shapes and functions adapted to the specificities of the musical communicative process, supplements extant knowledge of psycholinguistics and music psychology – instigating broader academic discussions regarding musical communication more generally.

3.1 Categorisations of gesture in music performance

In recent years, gesture-led research in the context of music performance appears to have recognised that the multifunctional character of gestures is not well served simply through the use of a traditional dichotomous approach to gestures as either 'technical' or 'expressive'. 'Technical gestures' were considered as those that allow the performer to physically produce the notes contained in the musical score, and 'expressive' as those gestures that allow the performer to achieve and convey an expressive effect (see Delalande, 1988). The problem of such a reductive approach is that most gestures in music performance can be simultaneously technical *and* expressive, and thus the extant categorisation does not provide a realistic judgement about the role of gesture in this complex and nuanced context. King and Ginsborg (2011) consider that recent research on gesture categorisation can be loosely grouped under the following three approaches: 1. *Functional gesture classifications*, focusing on the effects of gesture for and during sound production (e.g. Jensenius et al, 2010); 2. *Classifications focused on the physical posture used by performers*, in which researchers mostly adopt Delalande's argument that each gesture type demonstrates an expressive behaviour related to different body postures (e.g. Wanderley & Vines, 2006); and 3. *Classifications of communicative gestures*, which apart from the ones considering body postures (as above) also include extensive research carried out by Davidson (Davidson, 1993, 1994, 2001, 2005, 2006) – in which Ekman and Friesen's (1969)[33] psycholinguistic classification of communicative non-verbal behaviours has often been used to study communicative and expressive processes in the musical performance context. Within the above-mentioned trends, gestures in musical performance have been explored specifically in relation to: descriptive features of gesture (speed, spatial characteristics, duration, frequency, range) (e.g. Clarke & Davidson, 1998; King, 2006; Wanderley & Vines, 2006; Williamon & Davidson, 2002); the conditions in which gesture is generated (e.g. biomechanical and motor constraints) (e.g. Davidson, 2007; Visentin et al., 2008); and at the communicative or functional level, where the purposes and intentions of a certain action or gesture can also been examined (e.g. Clayton, 2005; Davidson, 2006; Rahaim, 2008, 2012).

Regarding functional approaches to musical gestures, the latest version is that of Jensenius et al. (2010), which consists of an amalgamation of previous functional

[33] Ekman and Friesen (1969) classification of non-verbal behaviours is discussed in greater detail in Section 3.1.1.

musical gesture classifications. The amalgamation is based on work by Gibet (1987), Cadoz, (1998), Delalande (1988), and Wanderley and Depalle (2005), and it distinguishes between gestures under the following rubrics: '*communicative'* (intended mainly for communication and, according to the authors, can be classified using McNeill's 1992 and 2005 classification); '*sound producing'* (effectively productive of sound); '*sound facilitating'* (supporting sound production in various ways); and '*sound accompanying'* (not involved in sound production, but following the music). There are a number of drawbacks with this categorisation, but the major problem resides in the fact that 'sound producing', 'sound facilitating' and 'communicative' gestures often overlap, making it difficult to specify what function or functions a certain gesture may assume in a given context (Dahl et al., 2010). The authors are aware of such overlap and state that "different categories are not meant to be mutually exclusive, as several gestures have multiple functions" (Jensenius et al., 2010: 24). However, the practical difficulty of ascribing greater levels of functional specificity to gestures while using this categorisation contributes to a dilution of the established categories and difficulties in gestural annotation that restrain further empirical considerations. Moreover, on the one hand this categorisation assumes that "all performance movements can be considered as a type of communication … ranging from communication in a linguistic sense (emblems) to more abstract forms of communication" (Jensenius et al., 2010: 25-26). On the other hand, this does not provide suggestions as to how one might classify such abstract communicative gestures. Further still, if "all performance movement can be considered a type of communication" (*ibid.*), it is unclear why the above authors did not consider the other categories proposed (i.e. 'sound producing', 'sound facilitating', and 'sound accompanying') as inherently belonging to a larger and broader category of musical communicative gestures. And it is also uncertain as to how McNeill’s spontaneous co-verbal gestures classification (1992, 2005) is to be used in the music performance context. Should it be applied only in cases where there is associated verbal content (e.g. singing or talking)? Or should it be used in a broader and more abstract sense, in which musical content would or could entail similar ideas to those expressed in speech? Given the appointed reasons Jensenius et al.’s (2010) framework appears to be of questionable practical application.

With respect to approaching gestures from the point of view of body posture, Delalande (1988, 1995) analysed Glenn Gould's gestures while performing Johann Sebastian Bach’s *The Art of the Fugue* specifically focused on piano performance and found five interconnected psychomotor organisations, which he named *gesture types*. According to Delalande, the body postures represent an expressive characteristic encompassing a psychomotor organisation and an expressive content that represent unified *expressive schemata*. It is argued that each gesture type demonstrates an expressive behaviour related to different body postures: ‘*recuilli*’ (meditative), ‘*vibrant*’ (vibrant), ‘*fluant*’ (fluid), ‘*delicat*’ (delicate) and ‘*vigoureux*’ (vigorous). King and Ginsborg (2011) state that these gesture types can also be considered as types of ‘illustrators’ [defined by Ekman and Friesen (1969) as body movements, performed by the hands, face or head that occur simultaneously with speech] – given that these body movements occur simultaneously with musical performance and often illustrate an expressive behaviour. This work, aligned to Davidson’s (1993) later findings on the visual perception of musician’s body movements, which argue that performance gestures are not solely linked to sound production but also convey meaning about musicians’ expressive intentions, led to a focus on communicative gestures and on the so-called ancillary gestures. Ancillary gestures have been defined as those that can express musical intention, structure and emotion, and are not directly linked to sound production (see Rodger et al., 2012; Wanderley & Vines, 2006). Thus expression, either conveyed through specific body postures and connected to certain musical intentions related to musical structure and/or performers' inner emotions, can provide a contextual basis for gestural analytical considerations.

Regarding communicative gestures, previous attempts at establishing parallels between gestures used in musical performance and rehearsals, to those used in everyday human communication (e.g. Davidson, 2005; Fulford & Ginsborg, 2013; King & Ginsborg, 2011) supported by co-verbal gesture classifications of Kendon (1980), McNeill (1992) and Cassell (1998), have a number of limitations. To begin with, in establishing such parallels, researchers began with the assumption that gestures used in music performance would mirror speech patterns (e.g. Davidson, 2005). This analytical angle contributed to an overlooking of the specificities of musical communicative gestures in terms of their own production features (gesture shape and forms) and the intrinsic nature of musical communicative processes – which might as well be of a different nature than speech-related communication. On top of this, if communicative musical gestures do not necessarily mirror speech a vital question needs to be asked: what criteria can be used to differentiate between gestures used in everyday human communication and musical gestures? Attributing a musical terminological title, such as the recently termed 'Musical Shaping Gestures' (MSG) (Fulford & Ginsborg, 2013) does little to differentiate the terms, and thus it is impossible to establish when a gesture is a musical shaping gesture rather than merely a spontaneous co-verbal gesture (King, 2013). The above considerations lead me to speculate that gestures observed in the context of this research may have a different communicative nature than the gestures recognised by McNeill. If this is so, a purely functional classification of musical gestures which looks to gesture only in relation to its resulting effects (in relation to sound production) may not serve the communicative aspect of communicating musically, while teaching and learning music; and, in such cases, an appropriate and context-based gesture classification is needed – one that takes full account of form, meaning and function in order to locate gestures and musical gestures in the pedagogical context. However, such assumptions require closer analyses of the considerations made about spontaneous co-verbal gestures from the field of psycholinguistics (Section 3.1.1). In addition, given that the process of musical communication includes gesture, musical and speech communicational channels, further considerations for establishing parallels between gesture, music and speech, also need to be devised (see Section 3.1.2)

3.1.1 Understanding co-verbal gestures classifications

In the field of psycholinguistics, gestures have been considered in relation to their form, meaning, function, semiotic properties, and whether or not they co-occur with speech. Following work previously developed by Efron (1941/1972), Ekman and Friesen (1969) categorised 'non-verbal behaviours' in relation to the presence or absence of speech in a topology of five categories: *'Illustrators'* (body movements, performed by the hands, face or head that occur simultaneously with speech); *'adaptors'* (body movements that manipulate one's physical self, usually performed without gesturer awareness and not intended to convey a message); *'emblems'* (body movements culturally specific and with precise meanings); *'affect displays'* (mostly facial movement associated with emotional expression); and *'regulators'* (body movements that mediate the flow of communication and so are interlaced with moment-to-moment speech flow, sustaining speaker and listener turn taking in a conversation). Later, Kendon (1980) classified gestures in relation to their use within and alongside verbal language as follows: *'gesticulation'* (idiosyncratic spontaneous movements of the hands and arms that accompany speech' (see also McNeill, 1992: 37); *'pantomime'* (gestures that can depict actions, objects or a story that are never accompanied by speech); *'emblem'* (as described above); and *'sign language'* (include for example the American Sign Language system[34]. Elaborating on the above, McNeill (2000) analysed the gesture categories proposed by Kendon (1980) not only in relation to speech, but also regarding the relationship with linguistic properties, conventions and character of the semiosis, in what became known as the Kendon's Continuum (a title given by McNeill aimed at honouring Kendon's contribution that became widely used in extant literature). Table 3.1 (next page) summarises the differences between these gesture categories along the four continua established by McNeill (2000).

Gesticulation or gesture, as respectively used by Kendon (1980) and McNeill (1992, 2000) are thus defined as motions mostly performed with the arms and hands (but not restricted to these body parts) that embody a meaning relatable to the accompanying speech and are the most frequent type of gesture in communication (McNeill, 2005). This is to say, that they are only meaningful if accompanied by speech. However, they do not include linguistic properties given that "they are not morphemic and do not obey phonological constraints, and cannot be syntactically combined with other gestures" (McNeill, 2000: 3). Because gesticulations do not obey grammatical conventions (as discussed above), they are global (the meaning of

[34] Despite the fact that it is possible to speak while performing sign language, sign language can be fully understood without speech given that is it composed by signs that have linguistic properties equivalent to lexical words (McNeill, 2005).

the parts is determined by that of the whole) and synthetic (incorporating the meanings of the speaker) (see McNeill, 2000).

Table 3.1. Kendon's continuum as established by McNeill (2000).

Gesture types	**Gesticulation**	**Emblems**	**Pantomime**	**Sign language**
Relation to speech	Compulsory presence of speech	Presence of speech is optional	Compulsory absence of speech	Can be produced with or without speech[35]
Relation to linguistic properties	Absence of linguistic properties	Some linguistic properties are present	Absence of linguistic properties	Linguistic properties are existent
Relation to conventions	Do not obey to conventions	Partially conventionalised	Do not obey to conventions	Totally conventionalised
Character of the semiosis	Global and synthetic	Segmented and synthetic	Global and analytic	Segmented and analytic

Investigations conducted by McNeill regarding the use of gesticulations across different languages (English, Japanese, Mandarin Chinese, Korean, Spanish, German, Italian, Turkish, Georgian, Russian, American Sign Language, Taiwanese Sign Language, and a few African languages) revealed that gesticulations combine universal and language-specific features, and are used by speakers of every language. Moreover, he found that speakers of different languages presented similarities and differences in their use of gesticulations. Differences across languages were attributed to the specific types of languages being either [S-type][36] or [V-type][37], consider-

[35] Although in sign language, it is possible to produce sign and speech simultaneously, there are claims that hearing signers consider the production of signs accompanied by speech disruptive (McNeill 2006: 59).

[36] **S-type languages** [as per Talmy's (1985, 2000) typology] are 'satellite-framed'. 'Satellite' is defined by Talmy (2000:102) as "a grammatical category of any constituent other than a noun-phrase or prepositional phrase that is in a sister relation to the verb root". English, Germanic and Chinese are examples of S-framed languages. For example, in the phrase: "Mary ran into the house", the verb encodes motion and also how the motion was executed.

ing Talmy's typology (1985, 2000). Although it is primarily made with the hands or arms, it is possible to form a gesticulation with the head or foot. As Goldin-Meadow (2003: 4) points out, "gesticulations…can beat the tempo of speech, point out references of speech or exploit imagery to elaborate the contents of speech". These gestures are produced as part of a spontaneous and intentional communicative act and enable people to project their ideas in ways unavailable to them through speech alone, and are an integral component of the conversation. There is an array of different classifications of 'gesticulations', and a diverse array of other terms has been used to designate this term, such as: 'illustrators', 'Spontaneous co-verbal gestures' or 'co-verbal gestures' (for reviews see Kendon, 2004 and McNeill, 1992). However, the most relevant and widely used classifications of gesticulations are the following three proposed by Ekman and Friesen (1969), McNeill (1992), and Krauss, Chen and Gottesman (2000). Ekman and Friesen's (1969) categorisation contains six categories of gestures: *'kinetographic'*; *'spatial movement'; 'pictographic'; 'ideographic'; 'deictic' and 'baton'*[38]; Krauss, Chen and Gottesman (2000) add several of the previous types together into a three layer only categorisation: *'Lexical', 'deictic' and 'motor gestures'*[39]. McNeill's spontaneous co-verbal gestural classification (1992;

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[37] In **V-type languages** [as per Talmy's (1985, 2000) typology] the path of a motion is usually encoded by the main verb and the motion expressed by a grammatical optional element and manner is typically omitted. Examples of V-type languages include French, Semitic languages, Japanese. Example: "Alex est entre dans la maison".

[38] **'Kinetographic gestures'** depict action/s either of a person or an inanimate being; **'Spatial movement gestures'** convey information related to how people and objects move in space over time; **'Pictographic gestures'** depict information related to shape and form, such as gestures performed while drawing.; **'Ideographic'** refer to aspects of an abstract nature; **'Deictic gestures'** convey information about location of people, and objects; and **'Baton'** emphasise the tempo of flow of speech and certain words or elements within phrases.

[39] **'Lexical gestures'** accompany speech and have relationships with verbal semantic content; '**Motor gestures'** consist of rhythmic repetitive movements that do not possess an obvious relationship with the semantic content of the accompanying speech; **'Deictic gestures'** are pointing movements usually performed with the index finger that serve to provide location indications regarding people, objects and directions. These gestures can refer to real, abstract or imaginary people, objects or things.

2005), which takes into account form and meaning, has provided the basis for much of the field of modern gesture studies, particularly in the fields of psycholinguistics, psychology and education. McNeill classifies gestures as: *'Iconic'* (representing images of objects and/or actions); *'Metaphoric'* (expressing images of the abstract); *'Beats'* (stressing important words and which are characteristically up-down movements of pragmatic significance) and *'Deictic'* (pointing movements).

Spontaneous gestures co-occurring with verbal language most likely manifest at moments of high communicative dynamicity in which one gesture can sometimes be ascribed to multiple categories (McNeill, 1992). For this reason, McNeill (1992) considers the above gesture-types as dimensions (e.g. *'iconicity'*, *'metaphoricity'*, *'deixis'*, *'temporal highlighting'*) rather than in a categorical sense, given the difficulty in categorising particular actions. Beats, for instance, can often combine with pointing, and in certain instances iconic gestures can also be considered deictic. With such multiplicities of functions and meanings, the author advises researchers to understand which categories or dimensions are dominant in the given context rather than being forced to fit gestures into a single category (McNeill, 2006). While speech content and context in which a co-verbal gesture occurs can effectively help determining a gesture dominant dimension/s, in music (perhaps with exception of instances in which gestures are performed alongside speech or singing) the content is not specific and does not have an exact equivalent semantic meaning. Thus, I argue that the overlap of gestural categories discussed in relation to Jensenius et al.'s (2010) work regarding categorising gestures performed in music performance can difficultly benefit from a similar psycholinguistic approach. The basic threads of such argument are those presented in the discussion regarding parallels between gesture, music and speech (Section 3.1.2 of this thesis). In terms of functions, spontaneous co-verbal gestures can: perform the same pragmatic functions as speech (Kendon, 1980; McNeill, 1992); emphasise information in an interlocutor speech, or add information not present in their speech (Goldin-Meadow, Nusbaum, Kelly & Wagner, 2001); have a role in a speakers' conceptual plan of speech (Alibali, Kita, Bigelow, Wolfman & Klein, 2001); be used for indicating a listener's active engagement in the conversation (de Fornel, 1992); retain turns in conversation (Duncan, 1972); have a role in indicating transition in language and cognitive development (Goldin-Meadow & Alibali, 1985); facilitate lexical retrieval (Morrel-Samuels & Krauss, 1992); and reveal speech production difficulties (Feyereisen, 1987). With regard to how gesture nurtures human communication, it has also been posed that hand gestures:

> [A]id in the structuring and making sense of the world; serve for orientation within and understanding of the world-within-sight (but beyond reach of the hands); can represent or depict the world in its absence, within the gesture space… that is created by the participants' orientation to the gesturing hands; are often used in combination with other bodily action, and can embody communicative action and discourse structure; can mediate and regulate transactions and construe content that is conveyed by the verbal utterance that they accompany. (Streeck, 2006: 71)

Such roles in human communication clearly emphasise that communicative considerations in the musical educational arena (and beyond) are incomplete if they do not account for the role of gesture. Although psycholinguistics co-verbal gesture classifications have been used by music performance research concerned with the role of gestures in relation to singing, such attention has yet to regard the role of such gestures in the instrumental and vocal music teaching scenario, as further discussed in the next sub-section (3.1.2). McNeill's (1992) classification provides an appropriate consideration of how intimately gestures and speech work together and therefore, I found it suitable for analysing the general communications between teacher and student in this context. However, further analysis is needed to establish whether this classification is suitable for analysing the process of musical communication between teacher and student and this is undertaken in Section 3.2.

3.1.2 Parallels between gesture, music and speech

Communication in the piano teaching and learning environment is carried out through verbal, musical and gestural channels. So looking at parallels between gesture, music and speech can yield preliminary answers to the question of how music, emotions, conceptual thinking and knowledge are communicated by teachers to students in the dynamically interactive scenario of one-to-one music tuition. Many parallels have been theorised between music and speech (e.g. Feld, 1974; Hatten, 1980; Johnson-Laird, 1988; Lerdahl & Jackendoff, 1983; Nattiez, 1977). Much less, though, has been said about the connection between music and gesture. This is striking, particularly as there are many similarities within the communicative parallels of gestures and music. Both can, for example, be: dependent upon a bodily interface and multimodal communication (facial, hands, etc.), and upon thought and intention to communicate; embedded and understood in a context-dependent basis (culturally understood); natural elements in everyday life, conveying information about culture, discourse, thought, intentionality, emotion, and intersubjectivity[40]; developed in close association to verbal language (e.g. singing; educational music contexts which use gestural, verbal and musical communicative modalities); performed without a verbal language channel (i.e. pantomime and sign languages; used in educational

[40] **Intersubjectivity** is a term used to emphasise the social dimension of human beings and the relations between people

music contexts which use gestural, verbal and musical communicative modalities) and in contexts of musical performance which may not involve verbal language); and understood as visual symbols – music in the context of notation or visual imagery, for instance. Both music and gesture are universal: all human beings produce the former (Bohlman, 2000), just as they produce the latter. Such interplay therefore encourages readings of music experience as "inseparable from the sensation of movement" (Leman & Godoy, 2010: 3) in terms of the interaction between mind and physical environment. However, music can never be entirely reduced to gesture. Although Dalcroze (1865-1950), Orff (1895-1982) and Kodály (1882-1967), anecdotally recognised the importance of gesture and body movement in music – albeit with varying levels of importance ascribed to gestural and movement components – there remains a need for systematic consideration of the perception and cognition of movement in the gestural processes of teaching/learning music. Stressing this further are empirical findings that cognition has its roots in kinaesthetic gestures that act as a pedagogic tool capable of transforming the mind's musical developmental process (Cohen, 1997). The need for identifying and categorising physical gesture, in a way that can enable systematic considerations for teaching and learning in general, is clearly necessary.

The blurred distinction between music and language has also generated noteworthy research. In the 1960s, for instance, linguists and musicologists collaborated to identify parallels between music and speech in terms of prosody and syntax (Johnson-Laird, 1988; Lerdahl & Jackendoff, 1983), and analogies of musical syntax with generative grammar (Feld, 1974; Hatten, 1980; Nattiez, 1975). In contrast, speech and music have been more recently theorised by Cross (2005: 35) as 'opposite poles of a communicative continuum'. Language can narrow down its possible referents

(Deacon, 1996; Sperber & Wilson, 1986), express semantically decomposable prepositions, and refer to unambiguous states of affairs. Music, to the contrary, is innately ambiguous and presupposes a set of actions/interactions: "its attributes of embodying, entraining and transposably intentionalising time in sound and action enables it to be efficacious in contexts where language may be unproductive" (Cross, 2005:35). As aspects of a "communicative continuum", language and music share common origins in terms of evolution. Thus recent theories of music and language evolution are persuaded that both evolved from a human mimetic and motor-modelling capacity built upon a social ontology based on gesture and preverbal spatio-temporal concepts (Tolbert, 2001: 84). This ontology is, according to Trevarthen (1999), linked with an innate musicality, which is socially and emotionally promoted. As such, language, gesture and music are embedded in a human dialectic continuum: "music plays a crucial role in individual and social development" (Cross, 2005:38) in similar ways as language itself.

In terms of parallels between gesture and speech, McNeill (2005), elaborating on the ideas of Vygotsky (1978), refers to language as an 'imagery-language-dialectic', in which gestures provide imagery. He considers gesture as an integral language component when synchronous and co-expressive with speech, arguing that the synchrony of speech forms and gestures creates the conditions for an imagery-language dialectic that fuels thinking for speaking as it seeks resolution. A similar parallel can be theorised for an imagery music dialectic, in which gestures can be considered as integral spontaneous components of music when synchronous and co-expressive with music. In this regard, Wanderley and Vines (2006) not only argue that the musical sound and the musician's ancillary and effective gestures arise from the same performance-expressive units, but also that musical gestures (in a musical performance environment) are rarely spontaneous – they are the result of a carefully rehearsed process. The context of instrumental music education undoubtedly differs from the context of musical performance. Firstly, musical gesture as imagery not only represents a link between music as sound, but also "an intersubjectively founded social and emotional content" (Kuhl, 2011:123). As such, gesture's expressivity not only relates to a musical content, but also to the global world/life/cultural context(s) from which it arises (Neuhaus, 1973). And secondly, although in the instrumental music teaching context a musically rehearsed approach to musical performance may be promoted, I argue that in the process of such promotion gesture occurs in a spontaneously musical and communicative human interaction. Thus, looking at gestures used in instrumental music communicative processes may be better done through a context-dependent lense.

3.1.3 Seeking a context-dependent ground for gesture

Given that gesture should be understood "in relation to a context-dependent aspect that concedes its expression and meaningfulness" (Leman & Godoy, 2010: 5), I argue that teachers' specific teaching behaviours can provide a contextual platform for understanding gestural meaning and functionality. One problem in implementing this argument is, however, the on-going terminological confusion about teaching styles versus teaching behaviours, whereby there is disagreement regarding the establishment of teaching behaviour categories. Since Abeles's (1975) work dedicated to establishing the characteristics of effective applied instruction, teaching behaviours have been approached by several researchers from instructional, behavioural and pedagogical points of view (Parkes 2009, 2011). According to Schmidt (1992), investigation efforts made since can be loosely grouped into the following categories:

development of instrumentation to measure teacher and student behaviour (e.g. Gipson, 1978; Hepler, 1986; Kostka, 1984); descriptions of teacher or student behaviour (e.g. Michalski, 2008); identification of factors that influence teaching or student behaviour (e.g. Albrecht, 1991; Gipson, 1978; Hepler, 1986; Kostka, 1984; L'Hommedieu, 1992; Levasseur, 1984; Schmidt, 1989a, 1989b) or teacher and student interaction (e.g. Creech & Hallam, 2003, 2011; Dickey, 1992; Gustafson, 1986; Siebenaler, 1997); and evaluation of instruction (e.g. Abeles, 1975; Duke, Prickett & Jellison, 1998; Duke, 1987; O'Neill, 1993; Schmidt, 1989a) or instructional methods or curricular practices (Gustafson, 1986; Jorgensen, 1980; Kurkul, 2007; Mackworth-Young, 1990, Wang, 2001). Kurkul (2007) points out two main problems in the above research. Firstly, most of the above literature with some few exceptions (e.g. Gipson, 1978; Levasseur, 1994; O'Neill, 1993; Wang, 2001) focus almost exclusively on verbal behaviours (for more detail see section 2.1). And secondly, one of the greatest problems of this research is the lack of clear definitions by researchers on their proposed categories. This is evident in Kurkul's examples in relation to the nine categories put forward by Gipson (1978), for which he only defined 'teacher musical directing' and O'Neill (1993) who included seven categories, however, only defining 'voice tone – friendly' and 'facial expression – friendly'. Because of the slippery and ambiguous nature of this terminology, for the purposes of this thesis I define teaching behaviours as specific, delimited teacher behaviours, performed during an instructional session with specific pedagogical intentions and functions, manifested by verbal and/or gestural channels. Furthermore, I hold that works by Zhukov (2004) and Carlin (1997) can be appropriately adapted and provide a contextual basis for the analysis of gesture. Table 3.2 (next page) presents a definition of the teaching behaviours categories as used in this work showing the adoptions and adaptations I have carried out to Carlin's (1997) and Zhukov's (2004) work on teaching behaviours for the purposes of the investigation reported in Section 3.2.

Table 3.2. Adoptions and adaptations made to Carlin's (1997) and Zhukov's (2004) work on instrumental music teachers teaching behaviours categorisation.

Authors	**Teaching behaviours**	**Adapted as:**	**Defined as:**
Carlin (1997)	Instructing	Giving information*	Teacher providing general and/or specific conceptual information
	Coaching	-	-
	Demonstrating	Demonstrating	Instances where teachers were showing the student how a particular action should be performed, without actively engaging the student in the action and in which the student was mostly listening and observing
	Playing	Playing piano*	Instances where teachers were intentionally and actively engaged with music making in the form of piano playing
	Other	Modelling	Instances where teachers actively engaged the student in performing actions alongside teachers' explanations
	Other	Listening/observing	Teacher presents physical stillness while internally processing the material presented/played by students in order to diagnose student needs, and establish a teaching plan of action suited to the student
Zhukov (2004)	Demonstrating	Demonstrating (*ibid.*)	(as above)
	General directions	-	-
	Reinforcement	Giving feedback*	Teacher evaluation of a student's applied and/or conceptual knowledge
	Questioning	Asking questions*	Enquiring
	Explanations	Giving information* (*ibid.*)	(as above)
	Giving advice	Giving advice	Giving a specific opinion or recommendation to guide the student's action towards the achievement of certain specific musical aims, without demonstration or modelling
	Practice suggestions	Giving practice suggestions*	Providing suggestions of ways to practise a particular passage or discussing a practising schedule
	Organisational skills	-	-

* To provide a more dynamic character to the previous categories and inculcate a sense of action, the adaptation made encompassed placing a verb before the specific category type

Although Carlin (1997) has proposed the following categories of teaching behaviours: *'Instructing', 'Coaching', 'Demonstrating', 'Playing'* and *'Other'*, I take the view that in this context teaching and learning processes can be, as a whole, defined as ‘Coaching’ (see Creech & Gaunt, 2012). Thus, from this work the categories ‘Instructing’ (here entitled as ‘Giving information’), ‘Demonstrating’ and ‘Playing’ (entitled more specifically as ‘Playing piano’) are taken. In terms of the openness provided by Carlin (1997) to researchers, through the inclusion of a category entitled ‘Other’ I have added the categories ‘Modelling’ (further discussed below) and ‘Listening/observing’. ‘Listening/observing’ was added in sequence of observations of the data material collected for the investigation reported on Section 3.2 whereby teachers frequently listened and observed students during the learning process. Zhukov’s (2004) categorisation contains a greater level of specificity in comparison to Carlin (1997) and previous researchers, and despite the fact that she mainly focuses on verbal behaviours, some of the categories she proposes are still well suited for use in this work. The greatest difference in relation to the teaching behaviour categorisation established for this work and Zhukov’s (2004) relates to the use of the term ‘Demonstrating’. Zhukov (2004: 197-198) acknowledges the term ‘Demonstrating’ as a way of ‘Modelling’, using these two terms interchangeably: ‘the teacher focuses on a specific element, allows the students to repeat it until it is corrected and then puts it into context by playing the entire passage”. This definition does not specify between the amount of student observation, nor the essential conditions in which the imitation takes place, or the fact that imitation is not always immediately put into context with the rest of the musical material. Indeed, teachers can at times demonstrate without requesting imitation, and this may have implications in terms of student learning outcomes.

The above terminological problems regarding the usage of the terms ‘Demonstrating’ and ‘Modelling’ are not only reflected in the work of Zhukov alone.

These problems persist on an interdisciplinary basis, where the terms 'Demonstration' and 'Modelling' have been used variously and inconsistently across a range of conceptual approaches, including motor learning research, instructional research, music psychology, and music education. In motor learning research 'modelling' is, for instance, used interchangeably with the term 'observational learning'; and the term 'demonstration' is more often used in the instructional context to refer to 'observational learning' (Magill, 2007). Due to these terminological inconsistencies, I have devised a differentiation between the terms 'demonstration' and 'modelling' to achieve greater clarity. In my differentiation, 'Demonstration' is defined as 'instances where teachers show the student how a particular action should be performed, without actively engaging the student in the action and in which the student is mostly listening and observing', and 'Modelling' as 'instances where teachers actively engage the student in performing actions alongside teachers' explanations. This differentiation operates in relation to 'seeing an action being performed' and 'seeing and executing an action', enabling further consideration into how particular teaching strategies can affect student learning. By taking teaching behaviours into consideration when analysing gesture in the piano and instrumental music teaching and learning context, it becomes possible to implement the framework of embodied music cognition proposed by Leman (2010) for studying gesture roles in the formation of musical meaning. He suggests a layered framework of analysis containing three distinct perspectives: a 'first person perspective' based on the interpretation of experiences and observations; a 'second person perspective' related to how gestures function as social cues, which here intimates 'seeing' and considering teachers' gesture not only into a general teaching role, but also embedded in specific teaching behaviours and an integral element of the teaching process. And a 'third person perspective' related to the measurement of either body parts or sonic forms, or both.

3.2 Study - Categorisations of physical gesture in piano teaching: a preliminary enquiry

In light of the above discussion, this empirical investigation is grounded upon a range of relevant and logical premises. This study begins with the assumption that studies in the context of instrumental pedagogy should consider the dialectical aspect of music education in which music is inseparable from life and from the world (Neuhaus, 1973). Such being the case, it is assumed that gestures should not simply be viewed from a solely functional perspective. Thus, in this study, gesture is approached in relation to its form/shape and meaning – with sensitivity to this particular context. Here it is implied that perhaps what can work in the context of musical performance may or may not be applied to the music instrumental teaching/learning contexts. Moreover, I consider it unjustified to assume that communicative gestures associated with music are the same as the ones associated with speech. It is evident that co-verbal gestures can have certain roles and functions when they accompany music education, performance and reception, especially in instances in which there may be a close interplay between music and speech. However, if speech and music are "opposite poles of a communicative continuum" (Cross, 2005), another logical assumption relates to the place of gesture as a communicative channel. Closer attention must be paid to music educational contexts to determine frequency, form, and functional significance of gestures in relation to particular teaching behaviours. In preparation for this investigation, it was anticipated that an exploratory case study with a small population sample would provide initial material for planning further detailed investigations, whilst answering the following research questions:

1. Which gestures are developed by teachers in one-to-one piano lessons while teaching beginner pupils classical music?
2. How adequate are McNeill's classification of spontaneous co-verbal gestures (1992, 2005) and Jensenius et al.'s (2010) functional classification of musical gestures, for use in this context?
3. Are the usage frequencies of different types of teaching behaviours the same or different with respect to each type of gesture?
4. Do different teachers use different types of teaching behaviours with divergent frequencies?

Answers to the first and second questions were sought through qualitative observation of video material, and for the third and fourth research questions the following hypotheses were established:

1. The frequencies of use of different types of gestures would be different with respect to each type of teaching behaviour.
2. The frequencies of use of different types of teaching behaviours would be different with respect to the three teachers.

The first hypothesis was based on literature dedicated to the relationship between verbal content and gestural production (Ishino & Stam, 2011), implying that different teaching behaviours may lead to different gestures as they involve communication of different information. The second hypothesis was grounded on findings that different teachers may adopt dissimilar teaching styles (Zhukov, 2004), consequently leading to different teaching behaviours.

3.2.1 Methodology

Participants

Participants were three experienced female piano teachers (teaching experience between 20 to 30 years, age range between 39 to 55 years old, one from Ireland and two from other European countries; two have a PhD and one a Master's degree in music and all have specific accreditation in piano teaching), each teaching one piano student of proficiency level equivalent to ABRSM Grade 1 standard (see appendix A for ABRSM piano grade 1 skill requirements). The three student participants were one girl and two boys with ages ranging between 8 to 10 years, engaged in piano tuition for a period of at least five months prior to this study.

Materials

In each session teachers worked with students on two pieces of set repertoire, chosen according to students' skill level: *Lullaby* by I. Philippe and *Study* by G. Humbert, both compiled and edited by A. Nikolaev (1978). The recording equipment consisted of a Sony video high definition camera. The digital video was converted to windows media file, transcribed, and annotated using the Elan Software programme (Lausberg & Sloetjes, 2009) (Appendix B contains an example of gestural annotation using Elan Software programme, as used for this thesis).

Procedure

The study consisted of a total of 18 teaching sessions captured on video. The video recordings were carried out in typical day-to-day pedagogical interaction and participants were unaware prior to recording about the focus on gesture in order to avoid distorting the lesson dynamics. Ethical approval was sought and obtained from the School of Creative Arts, Queen's University Belfast (Appendix C). After informed formal consent was obtained from the teachers and the children's parents (information provided to the participants is available in Appendix D), video recordings took place during the participants' usual piano lessons and according to their customary schedule. Only children that demonstrated willingness to participate took part in the study. The video camera was set up prior to the lesson, left unattended during the lesson, and placed at an angle that would enable the capture of teacher and student bodies and the piano keys. After each video recording, participants were met by a researcher who verbally assessed levels of awareness of the video camera. Participants confirmed that despite the presence of the video camera the lessons had unfolded as in normal day-to-day pedagogical interaction. A total of six teaching sessions (each seven minutes), for each of the three teachers were observed capturing first stages of engagement with the set repertoire.

Analysis

Qualitative observation. Each gesture was observed and classified according to shape/contour, contextual pedagogical meaning, function and for the simultaneous use of verbal, non-verbal and musical modalities (such as singing, marking the beat, playing piano, etc.). Repeated observations revealed that teachers used certain gestures for similar pedagogical and/or musical ends.

Categorisation. The data was categorised into two main areas: teaching behaviour (see Table 3.3, below - a simplified version of Table 3.2) and teachers' gestures (Table 3.4, page 101).

Table 3.3. Teaching behaviour categorisation in use for this study.

	Types	Definition
	Giving Information	Teacher providing general and/or specific conceptual information.
	Giving Advice	Giving a specific opinion or recommendation to guide the student's action towards the achievement of certain specific musical aims, without demonstration or modelling.
(Adopted and adapted from Carlin,1997 and Zhukov, 2004)	Giving Practice Suggestions	Providing suggestions of ways to practise a particular passage or discussing a practising schedule.
	Asking Questions	Enquiring.
	Giving Feedback	Teacher evaluation of a student's applied and/or conceptual knowledge).
	Demonstrating	Instances where teachers were showing the student how a particular action should be performed, without actively engaging the student in the action and in which the student was mostly listening and observing.
	Modelling	Instances where teachers actively engaged the student in performing actions alongside teachers' explanations.
(Present author)	Listening/Observing	Teacher presents physical stillness while internally processing the material presented/played by students in order to diagnose student needs, and establish a teaching plan of action suited to the student.

It was not possible to code the observed material according to the functional classification of musical gestures from Jensenius et al., 2010 as initially intended given the fact that the great majority of gestures developed by the participants in the course of teaching piano could fit simultaneously in several different categories. Rather, the authors created new categories (see Table 3.4, next page) named after general music literature and here designated as spontaneous co-musical gestures, in analogy to McNeill's (1992, 2005) work.

Table 3.4. Gesture categorisation in use for this study.

	Types	Definition
Spontaneous co-verbal gestures (McNeill 1992, 2005)	Deictic	Pointing.
	Iconic	express images of actual objects or actions.
	Metaphoric	express images of the abstract.
	Co-verbal Beats	Up and down movements of hand, arms and/or head with the purpose of highlighting information that is external to the gesture in itself, occurring at the meta-level of discourse.
Spontaneous co-musical gestures (present author)	Musical Beats	Up and down movements of hand, arms and/or head that only denote the tempo or speed at which the music should be played without providing expressive musical information.
	Conducting Style	Up and down movements of hand and arms, that assume generally a rounder shape providing temporal information and expressive information about the music.
	Playing Piano	Instances where teachers were intentionally and actively engaged with music making in the form of piano playing.
	Mimics	Instances where teachers appeared to mimic a certain mental image of a gesture that they considered appropriate to perform a particular musical sound producing action while expecting the student to imitate the gesture shown.
	Touch	Instances where teachers have made intentional physical contact with the student in the course of instrumental music teaching.

After the observations and annotation, the video material was offered to two independent annotators (in accordance with Bakeman & Gottman's 1986 requisites for observational techniques). The annotators were experienced piano teachers for whom the processes of gestural identification were carefully explained. Cohen's

(1960) Kappa agreement levels of at least .87 ($p < .05$) were achieved for both teachers' teaching behaviours and teachers gesture categories (see Table 3. 5, below).

Table 3.5. Cohen's Kappa inter-annotators agreement.

Categories	Number of references	Annotator pairs 1/2	Annotator pairs 1/3	Annotator pairs 2/3
Teachers' teaching behaviours	314	.93*	.87*	.93*
Teachers' gestures	639	.91*	.88*	.87*

*$p < .05$

Statistical analysis. A cross-tabulation analysis was conducted in SPSS containing the frequencies of use of nine types of gesture (Conducting Style, Co-verbal Beats, Deictic, Iconic, Metaphoric, Mimic, Musical Beats, Playing Piano and Touch) by seven types of teaching behaviour (Demonstrating, Giving Feedback, Giving Information, Listening/Observing, Modelling, Giving Advice/Practice Suggestions and Asking Questions) observed among three teachers based on a total of 639 observations. Pearson's Chi-Square tests were used to test the research hypotheses. The categorical data analysis assumed that (a) each category was mutually exclusive and (b) no other categories of behaviours or gestures were observed. Two original categories that contained many zeroes (Giving Advice and Giving Practice Suggestions) were collapsed into one category (Giving Advice/Practice Suggestions) for the purposes of analysis. Cramer's *V* coefficients were used to measure the correlations between the variables. The conventional interpretation applied was that $V < 0.1$ indicated little, if any, correlation; $V = .1$ to .3 indicated a weak correlation; $V = .3$ to .5 indicated a moderately strong correlation and $V > 0.5$ indicated a very strong correlation (Agresti, 2007).

3.2.2 Results

Gesture types, meaning and functions

From the 639 gestures found used by the three teachers across a total of 18 teaching sessions, the most frequent were: Deictic (39%); Playing Piano (14%), Co-verbal Beats (12%); and Metaphoric (10%). The less frequent gestures were: Iconic (7%); Mimics (6%); Musical Beats (5%); Touch (4%) and Conducting Style (3%) (see Figure 3.1, below).

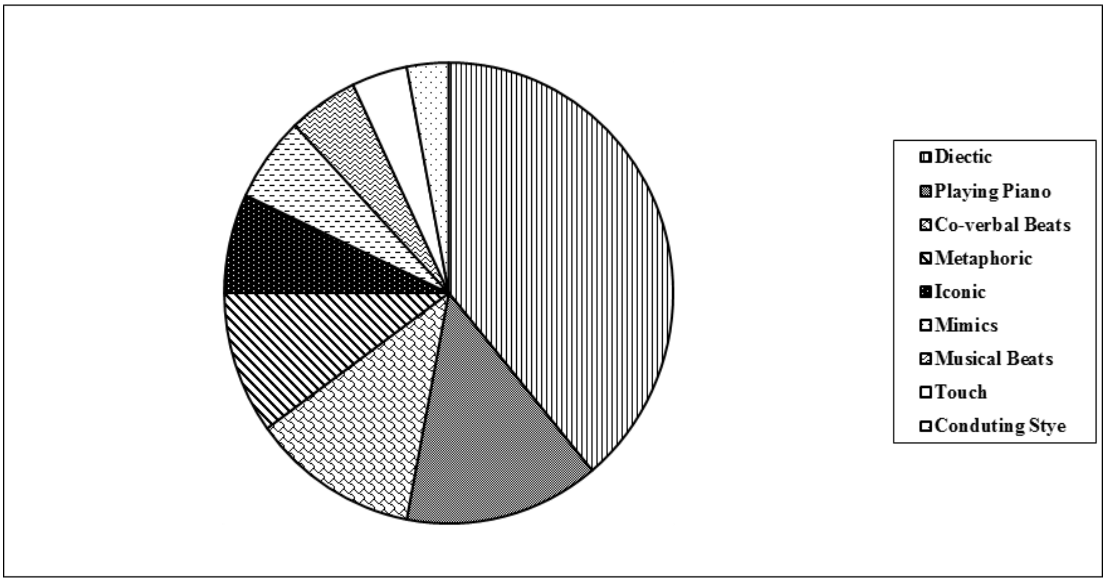

Figure 3.1. Gestures types used by the totality of teachers.

Teachers used Deictic and Playing Piano gesture quite consistently among each other but differed considerably in the use of other gestures: Teacher 2 used considerably less Metaphoric and Iconic gestures when compared to Teachers 1 and 3; Teacher 2 used Co-verbal Beats much more frequently than the other two teachers; Teacher 1 used considerably more Conducting Style gestures and Mimics than the other two teachers; but the other two appeared to use Touch more often than Teacher 1 (see Figure 3.2, next page).

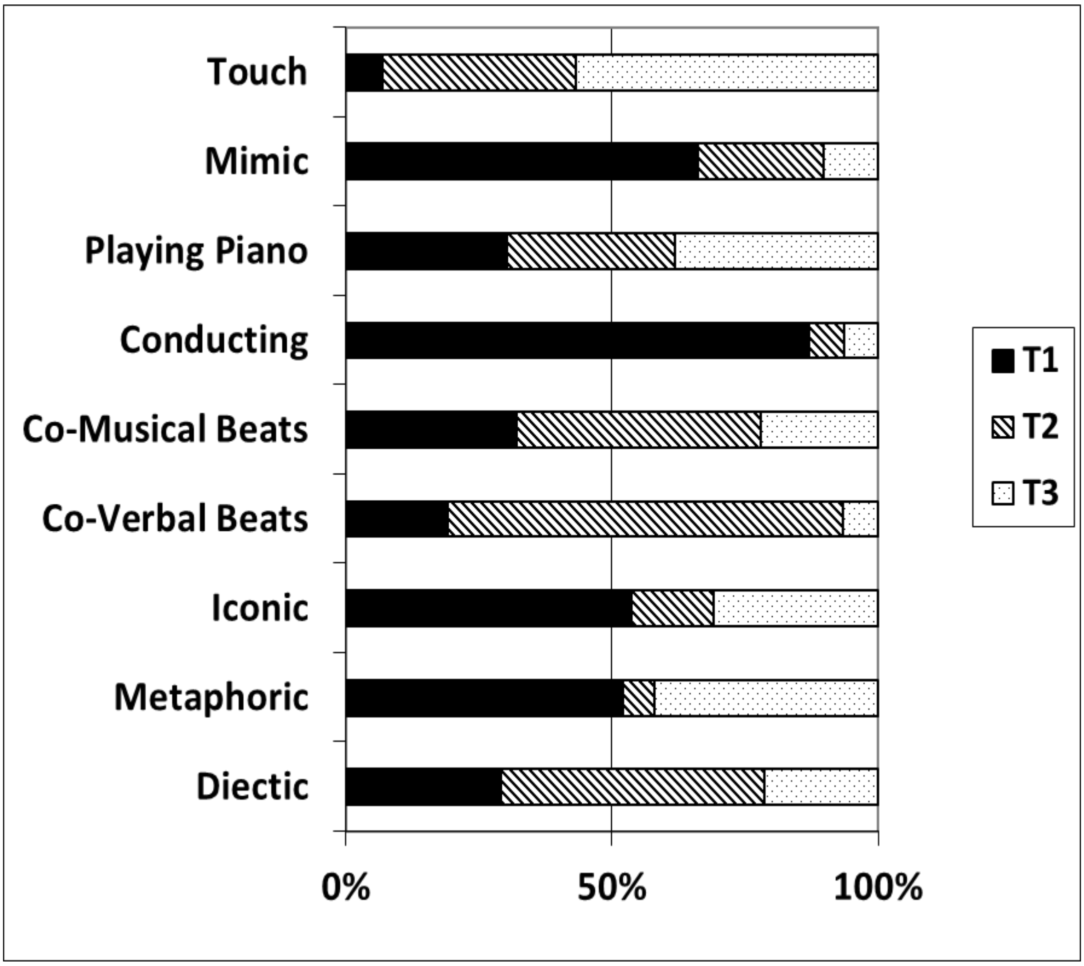

Figure 3.2. Gesture types individually used by the three teachers.

Spontaneous co-verbal gestures

Deictic gestures were used to point at the musical score, the piano keys, or to student body parts such as fingers, hands or arms and mostly used in association with verbal modality. Roughly 20% were allied with musical modalities (such as singing, marking the beat, etc.). Deictic gestures appeared useful in relating teacher and student to the musical metaphorical environment showed at the score by the means of notational icons, for synchronising teacher and student in the musical teaching and learning situation and also enabling teachers of showing to students where specific musical notes were located on the piano. Metaphoric gestures were frequently used in association with verbal language (89% of the cases) and used essentially as an aid to communication. A great majority of the Iconic gestures consisted of gestural descriptions of musical signs (particularly legato and staccato signs). In such cases, Iconic gestures were used to trace the shape of the musical symbols in the air, a process sometimes performed whilst pointing at these elements at the score, as if taking these signs ‘out of score’ to a physically performative arena. Co-verbal Beats served essentially communicative functions in association with verbal language.

Spontaneous co-musical gestures

Musical Beats assumed functions such as entrainment and synchronisation. Used regularly before starting the musical performance with the goal of setting the initial tempo, they appeared to function as a platform for synchrony between the musical interaction of teachers and their students. In terms of modalities: 42% of Musical Beats were associated with other musical modalities; 43% with verbal modality; and 15% with non-verbal. The essentially communicative nature of Conducting Style gestures related to specific musical functions, such as: facilitating sound production when preparing to start and/or end the sound producing gesture and promoting synchronisation between teacher, student and the musical piece. In 90% of the Conducting Style gestures, there were other musical modalities involved. In just 22% of Piano Playing gestures, teachers only played piano. The remaining 78% of Playing Piano gestures were performed in a highly communicative environment of playing piano alongside verbal explanations, often involving other musical modalities such as singing, marking the beat and was associated with Demonstrating, Giving Information, and Modelling teaching behaviours. Mimicking was shown to have specific musical functions such as facilitating sound production in terms of rectifying sound production gestures and/or movements with a view to improving performance and to promote imitative behaviour by the student (sometimes without giving a direct verbal indication for imitation). This was observed in instances of preparing to start and/or end sound producing gestures. This gesture was used quite consistently across musical modalities (30%), verbal (36%) and non-verbal modalities (34%). Touch appeared to be used for communicative purposes such as establishing a communicative channel, maintaining/recalling students' attention and specific musical functions, such as communicating: the weight of the hand to be used to press keys, the type of movement and physical posture of the hand, fingers and body to be used, the kinaesthetic sensation that should be felt and applied to the piano keys in order to produce the desired tone and preparing to start and/or end the sound producing gesture. Touch was mostly used alongside verbal modality (59%) with high metaphorical verbal content, but it was also employed in conjunction with musical modalities (34%), and in 7% of the cases with non-verbal.

Relationship between teaching behaviours and gesture types

The third research question (are the frequencies of use of different types of teaching gesture the same or different with respect to each type of teaching behaviour?) was addressed using the cross-tabulation in Table 3.6. The null hypothesis that the frequencies in the columns of the cross-tabulation would not be significantly associated with the frequencies in the rows was rejected at the 5% level of significance, indicated by Pearson's χ^2 (48, N = 639) = 376.36, p <.001. The correlation between behaviours and gestures was moderately strong, indicated by Cramer's V = .313. The main reason for this correlation was that the teaching behaviours were not equitably distributed across the gestures. In Table 3.6 (page 108) it can be observed that: Modelling behaviour mostly included Co-verbal Beats (71.4%), Conducting Style (89.5%) and Touch (74.1%); Deictic gestures were mainly observed during

Giving Information (39.9%) and Modelling (34.3%); Iconic gestures occurred mainly while Giving Advice/Practice Suggestions (26.7%) and Giving Information (37.8%); A wide variety of behaviours, including Asking Questions (14.1%) Giving Information (32.8%) and Modelling (17.2%) were associated with Metaphoric gestures; Modelling behaviour was mainly associated with the gestures classified as Mimic (57.9%) and Musical Beats (62.5%). The gesture of Playing Piano was observed mainly during Demonstrating (56.2%) and Modelling (29.2%).

Table 3.6. Cross-tabulation of behaviours versus gestures.

Gestures		Behaviours							
		Asking Questions	Demons trating	Giving Advice/ Practice Suggestions	Giving Feedback	Giving Information	Listening/ Observing	Modelling	Total
Co-Verbal Beats	Frequency	3	2	1	5	4	7	55	77
	% by Gesture	3.9%	2.6%	1.3%	6.5%	5.2%	9.1%	71.4%	100.0%
	% by Behaviour	7.7%	2.3%	2.9%	17.9%	2.4%	30.4%	21.2%	12.1%
Conducting Style	Frequency	0	0	0	0	2	0	17	19
	% by Gesture	.0%	.0%	.0%	.0%	10.5%	.0%	89.5%	100.0%
	% by Behaviour	.0%	.0%	.0%	.0%	1.2%	.0%	6.5%	3.0%
Deictic	Frequency	20	14	10	9	99	11	85	248
	% by Gesture	8.1%	5.6%	4.0%	3.6%	39.9%	4.4%	34.3%	100.0%
	% by Behaviour	51.3%	15.9%	28.6%	32.1%	59.6%	47.8%	32.7%	38.8%
Iconic	Frequency	6	3	12	3	17	0	4	45
	% by Gesture	13.3%	6.7%	26.7%	6.7%	37.8%	.0%	8.9%	100.0%
	% by Behaviour	15.4%	3.4%	34.3%	10.7%	10.2%	.0%	1.5%	7.0%
Metaphoric	Frequency	9	7	8	8	21	0	11	64
	% by Gesture	14.1%	10.9%	12.5%	12.5%	32.8%	.0%	17.2%	100.0%
	% by Behaviour	23.1%	8.0%	22.9%	28.6%	12.7%	.0%	4.2%	10.0%
Mimic	Frequency	0	6	0	2	7	1	22	38
	% by Gesture	.0%	15.8%	.0%	5.3%	18.4%	2.6%	57.9%	100.0%
	% by Behaviour	.0%	6.8%	.0%	7.1%	4.2%	4.3%	8.5%	5.9%
Musical Beats	Frequency	0	5	0	0	3	4	20	32
	% by Gesture	.0%	15.6%	.0%	.0%	9.4%	12.5%	62.5%	100.0%
	% by Behaviour	.0%	5.7%	.0%	.0%	1.8%	17.4%	7.7%	5.0%
Playing Piano	Frequency	1	50	3	1	8	0	26	89
	% by Gesture	1.1%	56.2%	3.4%	1.1%	9.0%	.0%	29.2%	100.0%
	% by Behaviour	2.6%	56.8%	8.6%	3.6%	4.8%	.0%	10.0%	13.9%
Touch	Frequency	0	1	1	0	5	0	20	27
	% by Gesture	.0%	3.7%	3.7%	.0%	18.5%	.0%	74.1%	100.0%
	% by Behaviour	.0%	1.1%	2.9%	.0%	3.0%	.0%	7.7%	4.2%
Total	Frequency	39	88	35	28	166	23	260	639
	% by Gesture	6.1%	13.8%	5.5%	4.4%	26.0%	3.6%	40.7%	100.0%
	% by Behaviour	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Note: 35, 55.6% of cells have expected frequencies < 5; Pearson's χ^2 (48, N = 639) = 376.36, p <.001; Cramer's V = .313

Teaching behaviours across teachers

The fourth research question (do different teachers use different types of teaching behaviours with different frequencies?) was addressed using the cross-tabulation in Table 3.7 (next page). The null hypothesis that the frequencies in the columns of the cross-tabulation would not be significantly associated with the frequencies in the rows was rejected at the 5% level of significance, indicated by Pearson's χ^2 (12, N = 639) = 52.65, p <.001. The correlation between teaching behaviours and the three teachers was however, relatively weak, indicated by Cramer's V = .203**.** Inspection of Table 3.7 shows that the main reason for the correlation was that the teaching behaviours were not equitably distributed across all three teachers. The frequencies of Demonstrating (16.9%); Giving Advice/Practice Suggestions (7.5%); Giving Feedback (10.0%) were consistently higher in T3 than in both T1 and T2, whereas the frequencies of Listening/Observing (2.5%) and Modelling (30.0%) were consistently lower in T3 than in both T1 and T2. The most frequent behaviours of T1 were Giving Information (32.0%) and Modelling (32.0%) whereas the most frequent behaviour of T2 was Modelling (55.1%).

Table 3.7. Cross-tabulation of behaviours versus teachers.

Behaviour		Teacher			Total
		T1	T2	T3	
Asking Questions	Frequency	16	14	9	39
	% by Behaviour	41.0%	35.9%	23.1%	100.0%
	% by Teacher	7.1%	5.5%	5.6%	6.1%
Demonstrating	Frequency	33	28	27	88
	% by Behaviour	37.5%	31.8%	30.7%	100.0%
	% by Teacher	14.7%	11.0%	16.9%	13.8%
Giving Advice/Practice Suggestions	Frequency	14	9	12	35
	% by Behaviour	40.0%	25.7%	34.3%	100.0%
	% by Teacher	6.2%	3.5%	7.5%	5.5%
Giving Feedback	Frequency	7	5	16	28
	% by Behaviour	25.0%	17.9%	57.1%	100.0%
	% by Teacher	3.1%	2.0%	10.0%	4.4%
Giving Information	Frequency	72	50	44	166
	% by Behaviour	43.4%	30.1%	26.5%	100.0%
	% by Teacher	32.0%	19.7%	27.5%	26.0%
Listening/Observing	Frequency	11	8	4	23
	% by Behaviour	47.8%	34.8%	17.4%	100.0%
	% by Teacher	4.9%	3.1%	2.5%	3.6%
Modelling	Frequency	72	140	48	260
	% by Behaviour	27.7%	53.8%	18.5%	100.0%
	% by Teacher	32.0%	55.1%	30.0%	40.7%
Total	Frequency	225	254	160	639
	% by Behaviour	35.2%	39.7%	25.0%	100.0%
	% by Teacher	100.0%	100.0%	100.0%	100.0%

Note: No cells have frequencies < 5; Pearson's χ^2 (12, N = 639) = 52.65, p <.001; Cramer's V = .203

3.2.3 Discussion

Parallels between spontaneous co-verbal gestures and spontaneous co-musical gestures

The fact that the Jensenius et al. (2010) musical gesture classification could not be applied to this context and that McNeill (1992, 2005) could only be applied to spontaneous co-verbal gestures reveals that the context of musical performance is quite different from the instrumental music teaching setting, each requiring different research approaches. The findings demonstrate that the communication of musical knowledge encompasses a communicational atmosphere in which verbal and musical behaviours both operate simultaneously and independently.

Several key parallels can be established between the spontaneous co-musical and co-verbal gestures (McNeill, 1992, 2005). Spontaneous co-verbal gestures accompany and are synchronous with speech. In the context of this study, spontaneous co-musical gestures accompanied an intentional musical experience, in the form of teaching to play a musical instrument. These gestures were synchronous both to the music and to the experience of music making. Whilst spontaneous co-verbal gestures are "idiosyncratic spontaneous movements of the hands and arms accompanying speech" (McNeill, 1992: 41) generally occurring in highly dynamic communicative contexts (Ishino and Stam, 2011), the spontaneous musical gestures here observed were idiosyncratic and synchronous with the activity of music making. In the same way that verbal content can, in many instances, determine the type of gestures being used, musical content guided teachers' use of gestures. There were many occasions in which spontaneous co-musical gestures appeared to represent features of the musical content in the same manner that spontaneous co-verbal gestures "can represent features in the speech, complement it, or represent an aspect present in the speakers' thought but not expressed through speech" (Ishino & Stam, 2011: 4). This was particularly evident in cases where spontaneous musical gestures represented features in the musical score, such as the musical beat or expressive features. These gestures facilitated teaching attempts to represent material in the musical score, enabling teachers to project their ideas in ways unavailable to them through speech alone. While spontaneous co-verbal gestures only accompany speech and other speech related activities, such as singing (simultaneously a speech-related and music-related activity), spontaneous co-musical gestures accompanied either: speech and music making at the same time, or only music making. Spontaneous co-musical gestures differ from their co-verbal equivalents in terms of form/shape and the nature of their communicative function. While it can be argued that the Conducting Style and Musical Beats gestures are musically guided by specific norms and may therefore be ruled out as emblems (in opposition to spontaneous co-verbal gestures), it was observed that Musical Beats were used in this study in a relatively free and spontaneous manner, determined by the rhythmical perceptual needs of the students and Conducting Style gesture did not obey rigid conducting norms.

These findings suggest that McNeill's (2005) imagery–language–dialectic ideas can be extended to the field of music as imagery–music–dialectic. He considers gesture as an integral component of language when synchronous and co-expressive with speech, arguing that the synchrony of speech forms and gestures creates the conditions for an imagery–language–dialectic that fuels thinking for speaking as it seeks resolution. As such, Deictic and Iconic gestures (such as when teachers gesture by means of physically tracing musical symbols in the air) may assume an iconic referential that, in the context of instrumental music education has an ultimate pedagogical goal of meaning creation. Additionally, it can be argued that the Playing Piano gesture, which assumed in many instances a demonstrative function of what a teacher sought in terms of student musical performance, provided a musical–imagery–dialectic that fuelled student willingness to imitate the teachers' actions. Imitating can constitute much more than simply copying a teacher's actions providing an empathetic understanding of music in itself as a way of communicating feelings, motivations and intentions (Overy & Molnar-Szakacs, 2009; Rizzolatti & Arbib, 1998; Tolbert, 2001). Mimics in this study contributed to teaching the functional aspects related to learning to play piano promoting a students' creation of a symbolic and abstract repertoire of gestural memories (Tolbert, 2001). In addition, it contributed to the development of an imagery–music–dialectic between teacher, student and musical work.

Towards a categorisation of physical gesture in piano teaching

The findings of this study not only call for a categorisation of physical gesture for this specific pedagogical context, but also reveal important aspects to take into account in doing so. The prevalence of Deictic gesture in the overall gestures frequency in this study requires a closer consideration of this gesture type in the context of instrumental music teaching. Deictic gestures occurring without verbal language and allied to a strictly musical behaviour could be considered as spontaneous co-musical deictic gestures and as such, not limited to the use of verbal language. It was clear from the results that Deictic gestures have an important role in terms of ascribing meaning to the icons/symbols in the score and their translation to a self-functional experience, engaging mind and body. Although Conducting Style gestures are studied from the point of view of orchestra/choir direction and co-performers communication, only minimal reference is made to it in the music instrumental pedagogical literature (i.e. Neuhaus, 1973). The 3% figure of usage by teachers in the overall gestures frequency suggests that teachers may not be aware of potential benefits of using this gesture in this context. In addition, recent research asserts that in a musician's synchronisation with a conductor, the synchroniser's previous experience is the most important factor (Luck, 2011). This makes it possible to infer that individuals participating in instrumental lessons, in which teachers conduct during the lesson, may be better equipped to musical ensemble playing than students of teachers who do not conduct. The Playing Piano gesture results from a process of translation of the symbols/icons from the musical score to sound, through a physical and corporeal experience. The musical conventions are nevertheless always individually interpreted. As such, it is possible to argue that playing piano has as much of iconic as metaphoric status in terms of experience against claims that a gesture cannot assume such duplicity (e.g. McNeill, 1992). In terms of teaching students to use their body for playing piano, the Mimics gesture appeared relevant as teachers used it for explaining movement principles (in agreement with both students' health and safety and in alignment with the best interests of the work of music). However, there seems to be a contradiction between claims that the quality of a musical performance is directly related to how efficiently we use our bodies as musicians and the relatively low frequency of Mimics gesture as performed by the teachers in this context (only 6% of total gestures). Whilst there is a considerable amount of literature dedicated to piano touch and tone, recognising the importance of piano touch for sound and tone quality from the early stages of learning (see Dogantan-Dack, 2011), there are no specific instructions to teachers (except for the use of verbal metaphor) on how to practically teach a student how to touch the piano keys in order to produce desired tones. In this study, Touch amounted to only 4% of all gestures; however, as used by the teachers in this study (strictly when necessary) it proved to be an important tool for the context of piano teaching. A balance needs therefore to be achieved between pedagogical aims on tone and the reality that some students are very sensitive to being touched (Levasseur, 1994).

The moderately strong significant correlation found between teaching behaviours and gestures by the three teachers and the uneven distribution of gesture types between teaching behaviours would suggest that certain gestures have emerged in the teachers' approach as being more effective for communicating particular kinds of musical knowledge to the students. For example, Co-verbal Beats, Touch and Conducting Style were observed more often during Modelling than during other teaching behaviours, while Iconic gestures occurred more during Giving Information and Giving Practice Suggestions/Advice. However, the distribution of observed teaching behaviours was different across the three teachers and can be attributed to differences in teaching style (Zhukov, 2004). It would be interesting to investigate if similar results would be found with novice teachers and whether there is a genuine difference between the effectiveness of certain gesture types within different teaching behaviours, or if this is simply a matter of preference or style of the teacher. The association of spontaneous co-musical gestures with Modelling teaching behaviour suggests that these gestures are relevant and specifically used for communicating musical knowledge during the teaching/learning process. Viewing the data from the perspective of students and their gestures as part of music-making can also provide wide ranging information for areas such as music psychology, education and performance. The framework used in this study can be extended to other types of one-to-one music instrumental teaching/learning scenarios such as woodwind, string, brass, vocal teaching as well as expanded to encompass coaching of small ensembles and comparisons with conductors of small/large ensembles. It is clear that the intense communicative scenario of teaching to play a musical instrument paired with the dual symbolic and functional aspect of gestures requires a specialised gestural analysis taking gesture types (form/shape and meaning) and functions into account. Moreover, this intricate dual functionality cannot easily be disassociated.

The current investigation has a number of limitations. Firstly, the small population sample: only three teachers and three students. Secondly, the student population is relatively young and less experienced (8-10 years old engaged in piano grade 1). It is possible that teachers might give a different focus to gesture and musical embodiment when teaching students who are more fluent at decoding the musical score. And thirdly, the focus on teachers' gestures in a piano teaching/learning context implies that specific contextual adaptations may be required when applying the spontaneous co-musical gestures classification to other contexts of instrumental music teaching/learning.

3.2.4 Conclusion

The findings of this study revealed that the instrumental teaching context not only makes use of spontaneous co-verbal gestures but also avails from a set of gestures that, in analogy to co-verbal gestures, have here been termed spontaneous co-musical gestures. Whilst McNeill's (1992; 2005) spontaneous co-verbal gestures provide a relevant conceptual basis for theorising the interactional communication between teacher and student, spontaneous co-musical gestures were ubiquitous and an essential element in the process of musical communication between teachers and students. Moreover, teachers were observed as employing both spontaneous co-verbal and co-musical gestures simultaneously and in some cases independently for the achievement of specific music instrumental pedagogical ends. The strongly significant and moderate effect size of the correlation between teaching behaviour and gesture types suggests that there is a relationship between the didactic intention of the teacher and the forms of gesture they use to communicate information to the student. The nature and effectiveness of this relationship should be a subject of further investigation. Such a step might help in the development of teaching strategies alongside factors such as students' ages and skill levels. The communicative parallels established between co-verbal and co-musical spontaneous gestures can have important implications for piano pedagogy and fields of study invested in musical communication by instigating new lines of enquiry, promoting empirically based practical and useful knowledge for practitioners. These findings are specific to the context of the western classical music tradition and considerations of other musical cultures in which music notation may be regarded differently demand their own specific contextual approaches.

Chapter 4

Teachers communicating music through gesture across student skill level

For understanding a musical culture, its system of teaching … of both the conceptions and the sounds is clearly of primary importance.
(Nettl, 2012: 115)

This chapter begins from the relationship found (in the previous chapter) between piano teachers' didactic intentions and the forms of gestures they use to communicate information to students at piano grade 1. Teachers might have different didactic intentions when teaching students of dissimilar skill levels, given that content and specific teaching and learning aims must necessarily differ. However, can such differing intentions be reflected in the ways that teaching methods are altered for students of different proficiency levels? If tested against students from other piano proficiency levels, would a consistent teacher-gesture relationship emerge in line with the findings of teaching students at grade 1? In other words, do teachers alter their gestural behaviour depending upon their student's particular learning needs, or particular stage(s) of skill acquisition? These questions constitute the basis for the work developed over this chapter. Understanding teachers' gestural specificities in relation to student skill levels can provide information about processes of musical communication in the instrumental classroom. Here lies the importance of this study, because developing this understanding can also offer us a basis for studying the efficiency of such gestures for student learning in ways that can inform pedagogical practice. The context of this empirical investigation is grounded in literature-based considerations of the following topics: teachers gesturing towards communicating musical knowledge, musically (Section 4.1); teachers' communication of symbolic and functional musical knowledge (Section 4.2); and gestural scaffolding processes (Section 4.3).

Recently published in the journal *Psychology of Music* (Simones, Rodger, & Schroeder, 2014), the exploratory case study reported in this chapter (Section 4.4) compares the gestural behaviour of three piano teachers during individual lessons with students of differing piano proficiency levels (ABRSM standard) (see Appendix A for ABRSM standard skill requirements for piano grades 1-8, 2011-2014 period). The data was collected by means of video recordings of one-to-one piano lessons, and gestures were categorised using two gesture classifications: the spontaneous co-verbal gesture classification (McNeill, 1992, 2005) and spontaneous co-musical gesture classification – developed in the previous chapter (and see Simones et al., 2013). Poisson regression analysis and qualitative observation suggest a relationship between teachers' didactic intentions and the types of gesture they produced while teaching, as shown by differences in gestural category frequency between teaching students of higher and lower levels of proficiency. Such agreement between teachers' gestural approaches in relation to student proficiency levels indicates a teacher-gestural-scaffolding-approach whereby teachers adapted gestural communicative channels to suit students' specific skill levels. This work provides an original and unique contribution to literature in music psychology on the topic of scaffolding[41], which has, so far, largely been studied in relation to verbal communicational channels (e.g. Adachi, 1994; Kennell, 2002; Saxe, Gerhart & Guberman, 1984; Wood, Bruner, & Ross, 1976). In addition, in the field of psycholinguistics, there has been barely any research into the topic. Thus, this work raises further awareness of the need of more attention to be given to teaching gestural scaffolding strategies, not only in the instrumental music pedagogical but also by other relevant fields of studies, such as education and communication.

4.1 Teachers gesturing towards communicating musical knowledge musically

The word 'knowledge' is defined in the Oxford English Dictionary (OED) online[42] as "[t]he acquisition of, or fact of having acquired understanding; comprehension; expertise, skill". Over the last decades, cognitive-developmental (e.g. Bruner, 1966; Gross, 1974; Piaget, 1970; Vygotsky, 1978), and socio-cultural trends (e.g. Barrett, 2005; Lave & Wenger, 1991; Schirato & Yell, 2000) have emphasised that knowledge is resultant of the interaction between the individual and relevant others, such as relatives and teachers in educational contexts, within specific socio-cultural

[41] **'Scaffolding'** is a term usually employed to refer to adult sensitivity to a child's conceptual level. In instructional terms it refers to the specialised instructional support in place to best facilitate learning when students are introduced to a specific tasks or subject. Section 4.3 explores the meaning and significance of 'scaffolding' in more detail.

[42] **"knowledge, n."** *OED Online*. Oxford University Press. Retrieved May 20, 2014 from http://www.oed.com/

realities. Such interactive dynamic process is situated in mediated interactions between people in a continuous reciprocal process of *meaning* generation (see Amsel & Byrnes, 2002; Lave & Wenger, 1991; Salomon, 1993). Defining what we mean by ‘meaning’, however, is a difficult task. Cross and Tolbert (2009: 24) have this to say on the matter:

> When we say that something has ‘meaning’ we are claiming that our original something points to, or is attached to, or can be used to infer the existence of some other thing beyond itself. Some sort of relationship exists between our original entity or event and something beyond itself.

Specifically in relation to music and meaning, the same authors state: “When we engage with music, we tend to feel that has significance; it appears to mean something, even if that meaning is entirely personal to us” (*ibid.*).

Academic considerations of both ‘meaning’ and ‘meaning in music’ constitute an extensive topic debated from various standpoints (for a review see Cross & Tolbert, 2009), but this chapter focuses its attention on the ways in which teachers communicate musical knowledge and meaning through gesture. Elsewhere, relationships have been established between meaning, creativity and human basic needs. For instance, it has been suggested that the foundation of the arts and creative endeavour is built to address basic human needs such as the ability to “create”, linked with a need of “mutually belonging” and “meaning making” (Dissanayake, 2000: 156). Thus, instances of ‘communicative musicality’ play a vital role in developing human creativity (see Barrett & Tafuri, 2012: 298; see also Trevarthen, 2000; Malloch, stephen & Trevarthen, 2009; Trevarthen, Delafield-Butt & Shögler, 2011). In synchrony with this, elsewhere music educational processes have been acknowledged as creative acts both for teachers and students – requiring their spontaneous cooperation (Bannan & Woodard, 2009). This notion has also been emphasised by Campbell (2010) who suggests that people engage in music making experiences as a means of making meaning and communicating their understandings of their worlds. Drawing on the work of Merriam (1964), Campbell (2010: 304) states that the meanings taken from musical engagement include “emotional expression, aesthetic enjoyment, entertainment, communication, physical response, enforcement of conformity and stability of culture, and integration of societal norms and expectations”. These functions or functionalities of music have often been viewed in the literature in relation to learners in informal or formal instances of musical engagement (i.e. Barrett, 2005, 2012; Barrett & Tafuri, 2012; Byrne, 2005; Young, 2005). However, they can also be extrapolated to considerations regarding teachers involved in a process of musical engagement that is designed to inculcate the above functions of music in the process of teaching and learning.

The musician-teacher is, elsewhere, even regarded as “the bridge through which differentiated cultural experiences are integrated” (O’Flynn, 2005: 198) given that he/she is “an exemplar who embodies a contextualised understanding of music, literacy, orality, performance practice, creative musical expressions, and scholarship” (Jorgensen, 2008: 110). Such understandings have so far been considered in relation to processes of oral and aural transmission (e.g. Byrne, 2005; Young, 2005), leaving gestural communicational elements out of sight. And considerations from developmental psychology on the ways culture contributes to shape human thought through the so-called ‘cultural shaping process’ may serve to illustrate these points further. Day, French and Hall (1985) theorise the social origins of such a process as follows:

> First, adults transmit culture-specific knowledge and skills to children. Second, children practice new skills with adults. Third, children are socially encouraged to use acquired skills. Finally, interaction with adults and older peers provides opportunities for children to employ knowledge and skills that cannot be used when they are alone. (Cited in Adachi, 1994: 26)

Though this can describe what we acknowledge to be the instrumental teaching/learning environment with young children in useful ways, it is not entirely sufficient. In a more detailed manner and still in relation to the process of enculturation[43], Vygotsky (1981) points out that when adult and child are intended to share a same situation they need to create an 'intersubjective situation definition' – one in which they can both share and synchronise their way of perceiving objects and create action patterns. The 'cultural sign' in this scenario works as a mediator for establishing this intersubjective situation, and consists of means used by members of a certain culture, such as an 'indicatory gesture' (Vygotsky, 1986), 'verbal directives' (Saxe, Gearhart & Guberman, 1984), 'eye gazes' (Wertsch, McNamee, Gillian, McLane & Budwig, 1980), 'counting' (Saxe, 1977, 1979), and an 'external object as a reminder' (Vygotsky, 1981). Thus, it is apparent that communication is a contextualised practice where the production of meanings takes place (Schirato & Yell, 2000), and should be approached with a focus upon "communicative practices that are not dependent upon language-based thought" (Barrett, 2005: 264). This is especially the case given that "production and communication are inseparable" (Engestrom, 1993: 67); and according to activity theory, the context is an "activity system … which incorporates both the object-oriented productive aspect and the person-oriented communicative aspect of the human conduct" (*ibid.*). Thus, attempts

[43] **Enculturation** refers to the processes through which people learn and acquire required values and behaviours of their culture, which are appropriate to fit in and survive in that culture.

to understand the context need to consider action embedded in the communicational aspects.

Gestures and non-verbal cues such as ‘gaze’, ‘posture’, ‘timing’ and ‘modelling’ (Rogoff, 2003) are “essential to on-going participation in and development of human thought and action” (Barrett, 2005: 264). Hence meaning-making is bound to specific contexts in addition to being promoted and constrained by the situations in which they take place. This main premise of situated cognition theory (Lave & Wenger, 1991) has been expanded to the notion of ‘distributed cognition’ (Salomon, 1993) where it is argued that individual cognition is ‘distributed amongst persons, activities and settings’. In this view, the reciprocal influence of people over each other, and people over context/environment advocates that communicative processes in music are “fundamentally social and inherently communicative” (Barrett, 2005: 265). Gestures appear to have an important role in this reciprocal influence people exert over each other, particularly considering that evidence from the field of psycholinguistics shows that gestures correlate with intersubjectivity levels between people in terms of the sharing of thoughts, feelings, and linguistic meanings (Nathan & Alibali, 2011; Zlatev, 2008). Intersubjectivity involves not only understanding beliefs and other proposition-like entities, but also other less explicit forms of consciousness such as emotions, attitudes and intentions (see Tomasello, Carpenter, Call, Behne & Moll, 2005). It has been suggested that such an intrinsic way of understanding involves identifying with others on a direct bodily level, and thus its links to gesture’s role in this important process (Donald, 1991, 2001; Gallagher, 2005; Merleau-Ponty, 1945; Zlatev, Persson & Gärdenfors, 2005; Zlatev, 2005, 2007).

Gesture is also proposed to have a crucial role in the learning process. In relation to music it has been stated that "the body and its dynamic relationship with the world are a fundamental component of musical literacy at all levels of development and musical cognition" (Philpott, 2001: 80). A number of relevant academics dedicated to studying human development assert that bodily actions considered from a view of interacting with the world can be internalised as thought (see Bruner, 1966; Piaget, 1970; Vygotsky, 1966), implying a biological conditioning for learning through our bodily actions. Focusing on a case study of performance-based teaching and learning of Balinese gamelan by Australian students, Dunbar-Hall (2006) suggests that an embodied understanding of social and cultural beliefs and practices have an influence on kinaesthetic and aural musical learning, particularly in relation to memorisation and hierarchical interdependence of sonic elements. The author goes on to assume an important role for teaching processes and to recognise a need of potential ethnomusicological dimensions geared towards music education, particularly in what accounts for broadening teachers' musicianship and pedagogical strategies. Nevertheless, such considerations do not seem to include or acknowledge the role of physical gestures performed by teachers in promoting learning through bodily action and it remains unclear as to how teachers can efficiently contribute to children's musical socialisation.

This all leads to the conclusion that the learning and teaching experience in instrumental music education is a musical performance in an interactive discursive experience of action and movement, through which meaning is constructed in a process of cultural communication of music in a shared process. Such a shared process is a 'creative act' for both teacher and student, and it involves reciprocal cooperation and spontaneous motivation enveloped by gestural, verbal and musical behaviours. Such behaviours stem from a human communicative capacity – an innate human tendency to "mutually entrain our actions", (Clayton, 2009: 40); and the manipulation of a musical instrument entails the integral nature of mental and physical action, and a need of bodily structures for a process of music making. If "music functions as the symbolic expression of the main values, patterns or themes of a culture" (Nettl, 1983: 15), it becomes licit to ask what role/s can teachers' gestures assume in terms of the communication of musical knowledge, in its symbolic and/or functional aspects? Answering this question requires considerations regarding symbolic and functional musical knowledge (Section 4.2.) as well as inquiries into teachers' gestural scaffolding processes (Section 4.3).

4.2 Communication of symbolic and functional musical knowledge

In contrast with cultures where music is transmitted orally and holistically Kennel (2002: 244) states that one of the defining traits of the western classical music tradition is its focus on literacy and "the symbolic representation of ideas and procedures". From an account of the influence of teaching processes for child development, though not directly related to music education, the following quote provides further insights into how processes of symbolic representation might occur:

> What is unique about teacher-abstract communicative contexts…is that the child's conceptualisation created from the symbolic language used by the teacher, becomes symbolised linguistically and notationally, with the consequence of forging partnerships between thought and language, thought and notation, and language and notion. (Amsel & Byrnes, 2002: 261-262)

Applying this to the context of instrumental music teaching requires the addition of two other partnerships: thought and action; and action and notation. According to Nelson and Shaw (2002: 244), symbolic language involves communicating about a state of affairs as represented by a symbol. In relation to human development, education and enculturation processes, it is argued that the ways in which communicating about a state of affairs as represented contributes to knowledge and meaning generation resides on the fact that it "opens up a world of conventional representations that could not be opened unless one was communicating with symbols" (Amsel & Byrnes, 2002: 244). Thus symbols *become* social, shared, and form a system (Nelson & Shaw, 2002) providing people with tools for conceptualising, communicating and representing abstract aspects of the world (e,g. Lehrer & Schauble, 2002; Olson, 2002; Scholnick, 2002). The problem with this view is that, to a certain extent, it conforms to traditional assumptions that cognition is a process strictly guided by rule-governed manipulation of mental symbols, such as rules of grammar operating on words. Against such mental monopoly assumptions present views on the communicative essence of language argue that mental rules do not exist, but are immanent in the processing of non-symbolic content (Collier, 1998).

Obviously, actions can also achieve a symbolic status or be considered from the point of view of the functions such actions may assume (Abrahamson & Sánchez–García, 2014). A dividing line between what is symbolic and non-symbolic behaviour, or between what may be symbolic and functional, is both practically and conceptually difficult to realise given the dynamic interplay between these elements across the process of development. In addition, elsewhere it has been shown that a sign's status as symbolic depends upon contextual factors that permit its symbolic mode to dominate (see Budwig, 2002; Nelson & Shaw, 2002). And in such dynamic interplay, the element of human agency through action and behaviour requires further consideration; so does, moreover, an understanding of the nature of signs (including gesture), which can be viewed as communicational channels.

Gross (1974) points out five modes of symbolic behaviour that in essence characterise a culture: ‘the linguistic’, ‘the social-gestural’, ‘the iconic’, ‘the logico-mathematical’, and ‘the musical’. From this perspective, the ability to perceive and manipulate symbols depends upon levels of competence in a symbolic mode and the process of understanding (receiving and decoding) is not passive. Symbolic competence, be it at the basic decoding or complex levels of appreciating and creating, is characterised and evidenced through skilful action, which in itself is intelligence and knowledge (Olson, 2002; Piaget, 1970, 1971). It is through such skilful action in a symbolic mode that knowledge can be acquired, maintained, extended, and utilised in creative and productive activity in a cultural medium (Olson, 1970). Symbolic thought and communication are appointed as the constitutive ingredients of the substance of culture leading to the view that educational systems should “be designed to encourage the acquisition of the widest possible range of symbolic competence” (Gross, 1974: 189). Symbolic communication means to understand others or express oneself with symbols “whether that involves communicating linguistically, mathematically, or through another symbol system expressed in speech, gesture, notations, or through some other means” (Amsel & Byrnes, 2002a: vii). Thus, it can be said that teachers and relevant others’ (i.e. parents, carers, siblings, etc.) symbolic communication (verbal, gestural, musical) instigates and promotes learners' development of symbolic thoughts and actions.

Learning to symbolise thought through language, gesture and notations provides both opportunities and additional learning problems: not only is there a need for managing the symbol systems in order to communicate precisely, but there are also more (and increasingly complex) partnerships to manage due to the increasing communicative options available (Amsel & Byrnes, 2002b; Olson, 2002). This broadly defines the essence of the process of music skill acquisition in which understandings leading to knowledge retention, both at conceptual and action levels, lead to further insights geared towards further developmental needs. Indeed, the importance of teachers in the process of human development and management of symbolic competence has been emphasised in educational contexts where children learn how to write (e.g. Budwig, 2002; Daiute, 2002). Daiute (2002) has shown that teacher and student oral dialogues promoted children's positive learning outcomes in writing performance: teachers engaged in cognitive control discourse (i.e., question asking, instruction, planning) and student-student oral dialogues provided a 'symbolic dialogic basis' for sharing fictional worlds that may assume similar functions as self-directed dialogues, so important in preschoolers' sustaining symbolic play. This is in agreement with other authors such as Amsel and Smalley (1999); Berk (1994); Vygotsky (1978).

In the music educational context (although this is not necessarily instrumental) similar accounts have been reported in terms of adult-child interaction. Adachi (1994) observes three roles for adults in adult-child musical duets: "transmitters of musical signs"; as "practice partners"; and as "co-players". She also describes how thought processes introduced by the adult are not fixed, but co-constructed through adult-child interaction in concordance with other notable authors (e.g. Barrett, 2005; Campbell, 2006; Lave & Wenger, 1991; Vygotsky, 1978, 1986; Wertsch, et al., 1980). In similar ways, Young (2005) identifies and describes the processes of imitation, elaboration and organisation in a detailed description of the communication between an adult community musician and a 4 year old. She proposes that improvisational dialogue should take place when considering the role of the adult in the music socialisation process with young children, shifting away from 'rule-bound' models. More explicitly, Byrne (2005) proposes a 'pattern and echo' technique based upon an initial simple pattern, proposed by the teacher and gradually evolving in complexity according to the learner's level of ability. As North and Hargreaves state, "this method can be used by skilful teachers to suit pupils' different paces of learning" (2008: 317). This provokes important questions regarding the value-assignment of 'skill' from a given teacher, not least: what criteria do we use to consider (and, indeed, demarcate) non-'skilful' teachers? Considering the background of this section, a skilful music or instrumental music teacher could thus be defined as an individual engaged in supporting and promoting learners' development and acquisition of symbolic competence (ability to perceive, manipulate, appreciate and create symbols) in the musical mode of symbolic behaviour of their respective cultures. This is a shared, creative, active process (for both teacher and student) that makes use of symbolic communication through various communicative channels: speech, gesture, notations, or through some other means. It can be argued that teacher's mere engagement in this process might not in itself result or bring about teaching skilfulness in terms of how teachers enact the above processes for supporting and promoting learners' appropriate development. Thus, researching and devising efficient ways of developing teaching skilfulness is a relevant research avenue with direct implications in the learning process.

Undoubtedly, observing and imitating sounds and actions to achieve symbolic competence is crucial; and equally crucial is understanding what type of observational and imitational templates teachers provide to their students, in terms of gesture and action, and identifying whether differences in such templates yield different learning outcomes. The ability to decode the structure of musical organisation is dependent upon individual competence in a particular musical cultural code, or the style in which a musical piece and musical experience is formed; and how this occurs in terms of the effects of teachers' usage of signs and symbols for how student musical meanings and understandings are generated needs greater attention.

Regarding signs, Peirce's notion of thought (which influenced the work of developmental psychologists such as Piaget and Vygostky) is that the elements through which communication is carried (i.e. signs) are distinct from the concepts or ideas which are communicated.[44] Gestures considered as signs may be used to communicate iconically or symbolically (Goldin-Meadow, 2002). Considering gestures as signs, Goldin-Meadow (2002) argues that the sign-object relationship can be established differently depending upon whether or not gestures are used as primary communicative outlets (e.g. as used by congenitally deaf children whose hearing parents did not expose them to sign language), or as a secondary outlet (as used by hearing children of hearing parents who have oral language as their primary

[44] Peirce's (1839-1914) ground breaking work on semiotics (see 1868; 1903) is based on his distinction of three types of signs, which evidence the relationships between sign and object: An **'Icon'** can be considered as a sign due to features of itself that physically are correspondent to its object; an **'Index'** can also be considered a sign due to a correlative, factual or causal relationship with its object; and a **'Symbol'** can equally be considered as a sign given a conventional, though arbitrary and habitual association between itself and its object.

outlet). Used as secondary outlets, gestures convey information iconically by resembling or mirroring their objects (e.g. a person drawing a music legato sign in the air), or indexically (by literally pointing to the objects they refer to). Conversely, used as the primary communicative outlet (by deaf children of hearing parents who were not exposed to sign language) their dominant mode is symbolic. Moreover, Goldin-Meadow (2002: 150) states that iconic gestures, when appropriated for communication, have "language-like" characteristics such as morphological, grammatical and semantic properties that were consistent with ergative oral languages. In this sense, it can be said that the dominant mode of these gestures is symbolic given that they intentionally communicate actions and objects as represented (i.e, gesture-to-world relations) and form systems with other gestures (gesture-to-gesture relations) (Nelson & Shaw, 2002). Alibali and Nathan (2006) suggest that teachers' gestures can provide a spontaneous way for meaning to be attached to the objects of instruction. They support their claim, both on their specific findings and on the work of Harnad (1990), who suggests that symbolic competence can be achieved in two ways: through the use of 'iconic representations' that are analogues of sensory information, or by the use of 'categorical representations' which serve to encode invariant features of object and event categories.

From one point of view, there are claims from cognitive theories focused on human development (e.g. Bruner, 1966; Gross, 1974; Piaget, 1970; Vygotsky, 1966) that symbolic verbal communication is advantageous to improving the process of communication in itself. These rest upon two aspects: 1) symbolic communication can expand children's knowledge about aspects pertaining to the world which lend themselves to be conventionally represented and conceptually denoted by symbols, using different symbol systems (i.e., from oral language to inscriptions); and 2) it opens possibilities to select a symbol out of a system of symbols which can be used to communicate aspects of the world that can make communication more precise. From another point of view, gesture appears to be a powerful communicative tool regardless of the fact of its symbolic or non- symbolic use, as pointed out by Goldin-Meadow (2002) where she outlined the cognitive significance of gestures produced by hearing children, who otherwise use oral language as a primary communicative outlet. Despite being non-symbolic, these gestures still hold communicative and cognitive functions: they can convey thoughts or strategies on tasks that cannot lend themselves to be verbally expressed; they support memory for expressed ideas (although it is unclear if this happens at the encoding or retrieval stage); and they lessen the cognitive demands on the primary communicative outlet. This leads to the conclusion that, while expressing thoughts, lightening cognitive demands and supporting memory may be considered as cognitive consequences of the use of any type of sign (i.e., indexical, iconic or symbolic) – they are not unique to communicating with symbolic signs (Goldin-Meadow, 2002). This is practically demonstrated by the fact that the cognitive consequences of non-symbolic gestures do not support the beneficial values attributed to symbolic communication.

Much more work is needed "to examine whether and which kinds of factors influence symbolic dominance across the sign types of words, gesture, and inscriptions" (Amsel & Byrnes, 2002: 249). A major challenge in undergoing such work though, resides in the difficulty of identifying the transition processes by which a sign's status can be considered symbolic, and what contextual factors allow both the transition and its symbolic mode to dominate. In the instrumental music teaching context, where teachers are "transmitters of musical signs", "practice partners" and "co-players" (Adachi, 1994) such endeavor implies considerations on the relationships between *thought and action* and a*ction and notation* in the communication between teachers and students. Among several questions that can be asked are: how in this intrinsically interactive musical environment conventional and meaningful representations are generated? And, how musical symbols are used and transformed into social and shared systems through which people conceptualise, communicate and represent the intrinsically abstract nature of music? Answers to these questions can potentially open new windows of knowledge into the process of musical communication.

4.3 Gestural scaffolding processes

Developmental psychology has demonstrated how adults (mothers and caregivers) tend to guide and adapt their interactions with children on the basis of their own perception of the child's conceptual level (Saxe et al., 1984; Wood et al., 1976). In one key study, when interacting with children on a given activity, mothers of 3 to 5 year-olds modified their own behaviours according to their perception of the children's level of thinking in relation to the task (Wood et al., 1976). Sensitivity to a child's conceptual level is also known as 'Scaffolding': the idea that specialised instructional support need to be in place in order to best facilitate learning when students are first introduced to a new task or subject. Wood et al. (1976: 98) refer to six key strategies that adults employ when working with children: "recruitment, reducing degrees of freedom, direction maintenance, marking of features, frustration control, and demonstration". Scaffolding can be effectively related to the pedagogical environment of instrumental music education, as proposed by Kennel's (1992) 'Teacher Scaffolding Model', which was constructed for this context. At the heart of this model is the idea that the teacher selects and introduces specific tasks just beyond the student's current capabilities, which are accessible to the student only with the help of a competent teacher. From his observational work, Kennel concluded that teachers' choice of a scaffolding strategy is based on teachers' attribution of the reasons why a students' performance succeeded or failed. Kennel linked each of the scaffolding strategies ('demonstration', 'mark a critical feature of the task', 'task manipulation') to teachers' understandings of students' performance.

Other attempts of identifying scaffolding processes in the instrumental teaching context include Gholson (1998: 539-540) who grouped teachers' strategies as 'preparatory' (precursors of instructional intervention) and 'facilitative' (encompassing promoting a comfortable lesson, marking critical features of content, use of metaphor and focusing on students' weaknesses). (See also Adachi, 1994, Young, 2005 and Barrett, 2005, whose work is discussed in the previous section). In an influential study, Rosenthal (1984) compared the effectiveness of three instructional strategies in college music instruction: a *verbal instruction only*, a *model instruction only* (using a demonstration and modelling strategy), and *a combination of verbal and model instructions*. The results suggested that the model-instruction-only-strategy produced greater student learning outcomes evidenced by the number of student-correct-performed-measures, leading the researcher to conclude that demonstration and modelling strategies are effective teaching strategies. The importance of scaffolding processes in the instrumental music teaching context has also been emphasised by recent musical educational literature such as in the *Oxford Handbook of Music Education*, 2012. Here, considerations are made regarding "artful teacher scaffolding" (Marsh, 2012; Wiggins & Espeland, 2012), which is defined as a process which requires essentially high levels of understanding of musical, learning and creative processes in order to frame "the musical experience in ways that make musical ideas most accessible to learners. That is, most authentically connected to the ways they experience and understand music" (Wiggins & Espeland, 2012: 343). These ideas are in accordance with child development literature from authors such as Rogoff (2003, a follower of Vygotksy), who describes teaching and learning in terms of *guided participation*. According to Campbell, guided participation entails the following on teachers' behalves:

> As transmitters of their own musical heritage, teachers shape the musicianship of students, demonstrating through their own performance…they listen to students and respond to their individual needs … they offer ways to improve students literacy skills … and define new symbols as they occur in the notated repertoire…they recommend methods of practice…suggest opportunities of creative expression … Teachers are the musical agents, the models, and the motivating forces of their students. (Campbell, 1991: 276)

Despite the range of instrumental teacher roles specified here, the sole, implicit presence of gesture in the word 'models' captures the way that the role of the body has been overlooked as a primary means of 'communicating', 'teaching' and 'knowing' in this context. Such implied considerations can also be read in terms such as 'demonstration', 'task manipulation' and 'modelling' (used by researchers such as Kennel, 1992; and Rosenthal, 1984 as described above). Such is the secondary status given to gesture, that its acknowledgement as an important teaching practice is perpetually lacking and such ignorance prevents a holistic evaluation of teachers' teaching practices in relation to students' learning effectiveness. This situation is also evident in the fact that the training of music educators tends to be highly focused on content and curriculum, rather than on the development of musical communicative and interactive styles that can promote learning (Young, 2005). Undoubtedly, teaching and learning to play a musical instrument are at the same time conceptual and intensively physical activities, and the importance of establishing empirically-tested teaching practices that consider both verbal and gestural communicative channels has recently been demonstrated. In a recent study, students were taught using procedural[45] versus declarative[46] teaching strategies (Altenmüller, Gruhn, Parlitz & Liebert, 2000) and the findings revealed that learning the same musical content in different ways resulted in a significant difference in brain activation patterns. Overall, such findings call for greater attention to be given to instrumental teaching as a process in all of its communicative dimensions.

The challenge we face today is that relatively little is known about how teachers' communicative behaviours may vary in order to scaffold student understanding. Even in other strands of teaching and other fields of knowledge, gesture as form of scaffolding has rarely been considered and exceptions to this include Alibali and Nathan (2006) in the context of teaching algebra and Wang, Bernas and Eberhard (2001) study on the effects of teachers' verbal and nonverbal scaffolding on classroom performances of students with Down Syndrome. Alibali and Nathan (2006) found out that teachers use gestures in order to 'ground' their instructional language; while undergoing such assumption the authors base themselves on the work of Lakoff and Núñez (2001) to suggest that teachers link their words with real-world and physical referents such as actions, objects, diagrams, or other inscriptions through gesture. And thus, such a type of grounding may contribute to the information conveyed in the verbal channel becoming more

[45] **Procedural knowledge** is often referred to as 'knowing how'. It usually relates to knowing how to do things that involve certain body movements or how to use objects, such as riding a bike or playing a musical instrument. This type of knowledge is acquired through practice and repetition and becomes unconscious over time.

[46] **Declarative knowledge** is often referred to as 'knowing what'. It basically means knowing what the strategy being taught is and what it is meant to do, and can be consciously recalled.

accessible to students. Furthermore, different referents resulted in the use of different types of gesture, suggesting that in lessons involving different types of representational material, different types of gestural grounding will likely be used. Besides arguing in favour of a teacher gestural scaffolding approach (supported by the study specific findings), these authors also point to the fact that teacher's gestures may index their own cognitive state, drawing on research focused on gesture as serving cognitive functions for speakers (e.g., Alibali, Kita & Young, 2000; Goldin-Meadow, Nusbaum, Kelly & Wagner, 2001). Thus, to this moment it cannot be said with certainty whether teachers' use of gestures while teaching serve teachers' cognitive and reasoning purposes. Concomitantly, it remains to be seen whether gestures are used for student scaffolding purposes or whether both accounts are viable. Certainly, gestures used by teachers reveal aspects of their own thinking (see Goldin-Meadow, Alibali & Church, 1993; Schwartz & Black, 1996). Furthermore, Alibali and Nathan speculate that teachers' gestures may reveal aspects of their thinking, not only in relation to the teaching and learning content, but also about students' abilities – posing that "it is possible that teachers may use gesture differently when explaining the same content to different students, depending on their beliefs about the students" (2006: 17).

The importance of addressing teachers' gestural teaching strategies is becoming increasingly apparent. Studies conducted in non-educational settings show that addressees do in fact grasp information from speakers' gestures: speakers' gestures facilitate listeners' comprehension of the accompanying speech, especially when the verbal message is ambiguous, complex, or degraded in some way. This leads to the belief that it is likely that students' comprehension of the learning content may also be aided by teachers' gestures. More in keeping with the instrumental music teaching context – where demonstration, imitation and modelling are frequently used – are findings from psycholinguistics (though these are not directly related with teaching and/or learning to play a musical instrument). A recent study has shown how speakers' procedural information from gesture became incorporated into addressees' subsequent behaviour, revealing that addressees are able to extract fine-grained perceptual-motor information from gesture in day-to-day communication (Cook & Tanenhaus, 2009) (for more details about this study, see Chapter 2, Section 2.3.3). This is a relevant finding given that although it had been proposed that gestures emerge from perceptual and motor simulations during communication (Hostetter & Alibali, 2008; Kita, 2000; McNeill, 1992; Streeck, 1993), the extent in which speakers can provide reliable perceptual-motor information to addressees was not yet known. Thus, according to these findings, gesture may provide a helping hand for conveying information that cannot be expressed easily through verbal language, such as those that pertain to the performance of actions – perhaps riding a bicycle, or teaching and learning to play a musical instrument. Consequentially, identifying teachers' gestural specificities across student skill levels has the potential of not only providing information regarding the process of instrumental music teaching, but also to establish a basis for studying the efficiency of such gestures for student learning. This is a crucial step that can inform pedagogical practice quite considerably.

4.4 Study - Piano teachers' gestural behaviours across different levels of student proficiency

The research questions posed for this investigation are:

1. What gestures are developed by piano teachers while teaching piano to different levels of student proficiency?
2. What differences and similarities can be found in teachers' combined and individual gestural approach while teaching piano to different levels of student proficiency?

In common with the previous study reported in chapter 3, for the purpose of this investigation gesture is also defined as a body movement in the pedagogical process of music making that carries an intention (Gritten & King, 2011) and/or a perceived meaning (Hatten, 2006). Focus is specifically on teachers' gesticulations.

4.4.1 Methodology

Participants

Three female piano teachers took part in the study, one from Ireland and two from other European countries. Their ages ranged between 33 to 55 years and their teaching experience between 20 to 30 years. All have a music PhD and specific accreditation for piano teaching. Initially, the twelve students participating in the study were divided in four groups (each of three students) according to their proficiency levels (ABRSM standard): pre-grade 1, grade 1, grade 4, and grade 8 (see appendix A for ABRSM piano skill requirements for each grade). However, given the fact that a preliminary analysis revealed similar gesture types between teachers teaching students in pre-grade 1 and grade 1 and between grades 4 and 8, the four groups were amalgamated to two as follows:

- Group I: students in piano pre-grade 1and grade 1 with ages ranging between 5 and 10 years old (4 females and 2 males).
- Group II: students in piano grades 4 and 8 with ages ranging between 11 and 35 years old (5 females and 1 male).

Materials

The observation material consisted of a total of 72 video recorded teaching sessions. The recordings were obtained using a Sony video high definition camera, placed laterally to the piano in order to capture the student and respective piano teacher. The digital video was converted to a Microsoft Windows media file, transcribed and annotated using the Elan Software programme (Lausberg & Sloetjes, 2009) (see appendix B for an example). In each session, teachers worked with students on two pieces of a set repertoire, chosen according to students' skill level, as follows: Pre-grade 1: Birds (unknown composer) and Crane by M. Krasyev, both Compiled and edited by A. Nikolaev, 1978; Grade 1: Lullaby by I. Philippe and Study by G. Humbert, both compiled and edited by A. Nikolaev, 1978; Grade 4: Invention n.4 in D minor, J. S. Bach, BWV 775 and Adagio, in A minor By D. Steibelt; Grade 8: Invention n. 13 in A minor, J. S. Bach, BWV 784 and Nocturne in B major, op. 32, n. 1, by F. Chopin.

Procedure

A total of six teaching sessions for each of the teacher and student dyads were obtained, from which the first three minutes were analysed. Similarly to the study reported in the previous chapter, the recordings were aimed at capturing first stages of engagement with the set repertoire in typical day-to-day pedagogical interaction and as such, participants were unaware of the focus on gesture. Ethical considerations were the same followed for the reported study in Chapter 3 (see Appendix C for form concerning requiring ethics approval from the School of Creative Arts, Queen's University Belfast and appendix D for information provided to the participants). Video recordings took place during the participants' usual piano lessons schedule and only children that demonstrated willingness to participate took part in the study. The video camera was set up prior to the lesson, left unattended during the lesson, and placed at an angle that would enable the capture of teacher and student bodies and the piano keys. After each video recording, participants were met by a researcher who verbally assessed levels of awareness of the video camera. Participants confirmed that despite the presence of the video camera the lessons had unfolded as in normal day-to-day pedagogical interaction.

Analysis

Categorisation. Through qualitative observation, gestures were identified, observed for consistent differences across teachers and classified using the same gesture categorisations used in the study reported in Chapter 3: 1) spontaneous co-verbal gestures (McNeill, 1992, 2005) and 2) spontaneous co-musical gestures (Simones et al., 2013) (see Table 3.4, page 101). Inter annotator reliability was assessed (in accordance with Bakeman and Gottman's 1986 requisites for observational techniques) for 20% of the totality of the gestures identified. The annotators were experienced piano teachers, with previous experience of gestural annotation and to whom the processes of gestural identification were carefully explained/revised. Cohen's (1960) Kappa agreement levels ranged from .86 to .89 (all $p < .05$), based on 484 reference gestures.

Statistical analysis. The primary aim of the statistical analysis was to compare teachers' gestural performance while teaching each of the two student groups in question. Given the fact that the data consisted of a number of frequencies of categorical data, positively skewed, Poisson regression was considered the most suitable approach for establishing such comparison. This method gives the difference between frequencies of each gesture type performed by teachers for each student group, in the form of a ratio (if there is no difference at all between the two student groups the ratio is equal to 1). Aiming for a realistic picture of the context, two Poisson regression analyses were conducted respectively on 1) totals of combined teachers' gesture type occurrences per student groups and 2) individual teacher gesture type occurrences per student groups. The confidence interval for this study was set at 95%.

4.4.2 Results

A total of 2418 gestures were identified and categorised. For each teacher in this study the most frequent gestures performed while teaching both student groups were Deictic (pointing) gestures and Playing Piano. Subsequent analysis compared gesture frequencies of all teachers combined, and separately, gesture frequencies of individual teachers.

Gestures developed by the three teachers combined

The comparison of the combined occurrences of teachers' gesture types while teaching the two student groups in the study can be seen in Table 4.1 (next page), in which the last two columns show the results of the Poisson regression analyses. The difference between the occurrences of teachers' gesture types for students in Group

II (Grades 4–8) is given in relation to students in Group I (Pre-grade 1 and Grade 1). Metaphoric, Iconic, Co-verbal Beats and Conducting Style gestures were all significantly more common for students in Group II rather than Group I: the occurrence of Metaphoric gestures was 4.7 times higher, whilst the occurrence of Conducting Style gestures was 13.0 times greater for Group II. Conversely, Deictic, Mimic and Touch gestures were all significantly less common while teaching students in Group II in relation to Group I: Mimic gestures were only a third as common for teaching students in Group II than for students in Group I. A statistically significant difference between the two groups of students was not found, however, for Musical Beats and Playing Piano gestures (see Table 4. 1).

Table 4.1. Poisson regression results on teachers' combined gesture occurrences.

Gesture types	Occurrences for students in group I	Occurrences for students in group II	Ratio (Int/Beg) (95% CI)	P-value
Deictic	374	305	0.82 (0.70, 0.95)	**0.008**
Metaphoric	46	215	4.67 (3.40, 6.43)	**<0.001**
Iconic	95	193	2.03 (1.59, 2.60)	**<0.001**
Co-verbal Beats	92	191	2.08 (1.62, 2.66)	**<0.001**
Musical Beats	52	51	0.98 (0.667, 1.44)	0.92
Conducting Style	2	26	13.0 (3.09, 54.8)	**<0.001**
Playing Piano	230	206	0.90 (0.74, 1.08)	0.25
Mimic	155	52	0.33 (0.25, 0.46)	**<0.001**
Touch	124	9	0.07 (0.04, 0.14)	**<0.001**

Gestures individually developed per teacher

The results of Poisson regression carried out on individual gestural occurrences per teacher (Table 4. 2, next page) suggest that for some gestures the results were consistent between the three teachers, but for other gestures there were some differences in terms of the results obtained. Teachers' individual results were consistent and statistically significant for Metaphoric gestures and Co-verbal Beats, both more common for all teachers for students in Group II than for Group I. Iconic gestures were also more likely for students in Group II for Teachers 1 and 2, but there was no statistically significant difference for Teacher 3. There was no difference between student groups for Musical Beats for Teachers 1 and 2, but for Teacher 3 this gesture type was more common for students in Group II than for students in Group I. The occurrence of Conducting Style gestures was not significantly different between student levels for Teacher 2. However, a formal comparison was not possible between groups for Conducting Style data belonging to Teachers 1 and 3 due to the zero occurrences for students in Group I, although there were occurrences for students in Group II for both teachers. The results for the Playing Piano gesture varied between the three teachers: there was no difference for Teacher 2, but it was significantly lower for students in Group II for Teacher 3 and significantly higher for students in Group II for Teacher 1. The Mimic results suggested no differences between groups for Teachers 1 and 2, whilst the Teacher 3 results suggested fewer occurrences for students in Group II when compared to students in Group I. Touch gestures were significantly fewer for students in Group II based on the data from Teachers 1 and 2. There were no occurrences at all for Teacher 3 for either student group.

Table 4.2. Results of Poisson regression analysis on gesture occurrences individually performed per teacher.

Teacher	Gesture	Occurrences Students in group I	Occurrences Students in group II	Ratio (Int/Beg) (95% CI)	P-value
Teacher 1	Deictic	169	125	0.74 (0.59, 0.93)	0.01
	Metaphoric	14	90	6.43 (3.66, 11.3)	<0.001
	Iconic	22	100	4.55 (2.87, 7.21)	<0.001
	Co-verbal Beats	25	51	2.04 (1.26, 3.29)	0.003
	Musical Beats	42	28	0.67 (0.41, 1.08)	0.10
	Conducting Style	0	18		(*)
	Playing Piano	43	63	1.47 (0.99, 2.16)	0.05
	Mimic	19	16	0.84 (0.43, 1.64)	0.61
	Touch	15	2	0.13 (0.03, 0.58)	0.007
Teacher 2	Deictic	98	90	0.92 (0.69, 1.23)	0.56
	Metaphoric	29	80	2.76 (1.80, 4.22)	<0.001
	Iconic	42	64	1.53 (1.03, 2.25)	0.03
	Co-verbal Beats	52	100	1.92 (1.38, 2.69)	<0.001
	Musical Beats	5	1	0.20 (0.02, 1.71)	0.14
	Conducting Style	2	4	2.00 (0.37, 10.92)	0.42
	Playing Piano	71	56	0.79 (0.56, 1.12)	0.18
	Mimic	12	19	1.58 (0.77, 3.26)	0.21
	Touch	109	7	0.06 (0.03, 0.14)	<0.001
Teacher 3	Deictic	107	90	0.84 (0.64, 1.11)	0.23
	Metaphoric	3	45	15.0 (4.67, 48.3)	<0.001
	Iconic	31	29	0.94 (0.56, 1.55)	0.80
	Co-verbal Beats	15	40	2.67 (1.47, 4.83)	0.001
	Musical Beats	5	22	4.40 (1.67, 11.62)	0.003
	Conducting Style	0	4	(*)	(*)
	Playing Piano	116	87	0.75 (0.57, 0.99)	0.04
	Mimic	124	17	0.14 (0.08, 0.23)	<0.001
	Touch	0	0	(*)	(*)

(*) No formal analysis possible due to no gestures in one or more student group

Qualitative observation revealed specific consistent differences across teachers for use of certain gestures in relation to student experience level in the use of Deictic and Touch gestures. In using Deictic (pointing) gestures, teachers tended to point more at the student hands and piano keys while teaching students in pre-grade 1 and pointed more to the musical score when teaching students from grade 1 onwards. In addition, two of the teachers were observed touching students' hands and while doing so, playing piano with students' hands when teaching students in group I, an action not observed while teaching students in group II.

In sum, despite a certain level of disagreement between teachers in terms of the use of Musical Beats and Playing Piano gesture in individual results across student piano proficiency levels, the findings suggest a considerable level of agreement for the three teachers in higher usage of certain gestures types for specific student groups. Teachers' individual performance is in agreement with the combined results, except for the following: teacher 3 did not perform Touch gestures for either student group; contrary to other teachers, teacher 3 displayed higher frequencies of Iconic gestures for students in group I; and teacher 2 displayed higher frequencies of Mimic gestures for students in group II. Additionally, despite a certain level of agreement between the three teachers in terms of higher gestural frequencies for certain student groups, statistical significance in the individual results for each of the three teachers was only achieved for Metaphoric and Co-verbal Beats gestures. This can be attributed to lower frequencies of gesture types when looking at an individual teacher's results, in relation to teachers' combined results.

4.4.3 Discussion

The agreement reported in the present study between teachers in relation to students' experience levels is suggestive of a teacher's gestural scaffolding approach, in which they adapted gestural communicative channels to suit students' specific conceptual skill levels. In this regard, there are specific insights that this study can provide in terms of gestural scaffolding processes in piano teaching. Deictic gestures (pointing: performed more frequently by all teachers for students in Group I: pre-grade 1 and grade 1) appeared to have an important role in ascribing meaning to the icons/symbols in the score and in relating them to the experience of music making, both as a motive for and result of action. Thus, the pointed symbolic icons were translated to a practical self-experience which engaged mind and body, a process aided by teachers who frequently employed verbal explanations of contents alongside Deictic gestures during the students' performance experience processes. The fact that teachers pointed considerably more often at the students' hands and piano keys while teaching students in pre-grade 1, and pointed more to the musical score when teaching students in grades 1, 4, and 8, seems to emphasize a shift in the teaching process. In the earlier stages, a teaching practice based on a purely action-making activity seems to gradually give way to the importance given to the symbolic ascription of meaning to the musical icons as written in the score.

The higher usage of Metaphoric gestures (express images of the abstract, 4.7 times higher for students in Group II) and Iconic gestures (used for describing action, 2.0 times higher also for students in Group II), points to teachers' increased focus on musical-conceptual and motor-functional knowledge with advancing student proficiency level. As stages of learning advanced, teachers departed from the bare minimum of the perceptual-motor components of the task and appeared to gear the learning process towards the understanding of the activity in a more meaningful way. This way, they appeared sensitive to the importance of learning through hands-on experience as suggested by Piaget (1936) and Vygotsky (1986), building on the knowledge gained through action and introducing new knowledge gradually.

The results of Conducting Style gestures (13.0 times greater for students in group II and highly associated with singing, used for teaching aspects such as expression, phrasing and consistency of tempo) supports the above conjecture that teachers' gestural intentions are adapted towards higher-order musical elements in teaching more proficient students. Studied from a point of view of orchestra/choir direction (Boyes Braem & Braem, 2000; Poggi, 2007, 2011) and co-performers communication (Davidson & Good, 2002; Goebl & Palmer, 2009; Rahaim, 2008; Williamon & Davidson, 2002), only minimal reference is made to Conducting Style gestures in the music instrumental pedagogical literature (that is, Neuhaus, 1973; Simones et al., 2013). Since communication of emotion seems to be an agreed criterion when accounting for performance quality (Hallam, 2010; McPhee, 2011; Prince, 1994) and conductors gestures are by definition communicative (Poggi, 2011), it would be expected that teachers would use Conducting Style gestures to promote students' development of expressive skills from the earliest stages of learning. However, apparently, teachers in this study considered that students at the early stages of learning were not ready for working on expressivity, in line with findings that instrumental music teachers appear to focus more on technique rather than expressivity (Karlsson & Juslin, 2008).

The above contradiction between established teaching practice and recent views on music education as a platform for developing 'expressive, communicational and affective musical interactions' (Welch & McPherson, 2012) from the earliest learning stages highlights the need to explore strategies for teaching musical expression and communication. Mimic gestures were three times more common while teaching students in Pre-grade 1 and Grade 1 and the significant difference between student groups points to an important role that imitation appears to have for teaching body usage in playing a musical instrument at the early stages of learning. On one hand, instrumental teaching is criticised on the basis that teaching methods are often based on imitation and as such, do not lead to developing interpretative meaning-construction (e.g. Rodrigues, Rodrigues & Correia, 2009). Such preconceived notions of what creativity is, or is meant to be, appear to conflict with the role of imitation in the process of children's musical socialisation and in promoting and enabling creativity. On the other hand, claims that imitation *is* an important pillar for children's socialization (e.g. Bandura, 1977) are in accordance with evidence from the field of mirror-neuron research, which suggests that accommodating and appropriating the actions of others in one's bodily experience can provide an understanding of their motivations and intentions (Overy & Molnar-Szakacs, 2009; Rizzolatti & Arbib, 1998; Tolbert, 2001). Studying the mediator signs in this human interaction, and how they are used by teachers teaching children of different conceptual levels, appears to be a step forward in terms of understanding how musical communication is developed.

This work also provides a realistic demonstration that music production is intrinsically dependent upon gesture and body movements, as is the teaching process itself. Attempts made in terms of identifying and describing processes of imitation (e.g. Byrne, 2005; Young, 2005) would benefit from a specific consideration of gestural approach in terms of teaching guidance. Mimic gestures, as observed in this study, provided the form and trajectory of the intended action, while Touch (significantly more common for students in Pre-grade 1 and Grade 1) can not only guide and support the child in the action, but also serves as a channel for emotional communication: love, gratitude, and sympathy can be communicated between teachers and students through touch, and children who learn to communicate such emotions have been shown to be more cooperative in their interactions with others (Herterstein, Keltner, App, Bulleit & Jaskolka, 2006). As such, Touch appears to provide a platform for teaching the essential haptic contact required to play a musical instrument, in addition to being a form in itself of establishing communication with others and developing musical communication.

The present findings are suggestive of the importance of studying gestural scaffolding processes in the music instrumental teaching and learning context as the encoding of musical communication encompasses both verbal and gestural signs, through which interpretative meaning construction is developed. Previous research into scaffolding processes in the instrumental music context ascribed an important role to both verbal and non-verbal modelling (e.g. Dickey, 1992; Goolsby, 1996; Wang 2001; Sink, 2002). However, little attention has so far been given specifically to the so-called non-verbal modelling aspects of teaching to play a musical instrument. Recent calls for the importance of musical facilitators developing their practice by making a more extensive and optimised use of non-verbal modelling (Creech, Varvarigou, Hallam, McQueen & Gaunt, 2013) need to be accompanied and complemented by a deeper understanding of these so called non-verbal behaviours. In this regard, the term gesture instead of non-verbal behaviour appears to provide helpful insight for such study by allowing equal importance to verbal and gestural channels and acknowledging that verbal and gestural features can, in fact, occur simultaneously and complement each other.

Recommendations for teaching stemming from these findings should only be brought forward with an understanding of the importance of teachers' gestures for student learning. As such, the priority from a research point of view is to understand if teachers' gestures are helpful for student learning and, if so, how and to what extent. If it is convincingly demonstrated that teachers' gestures are important for student learning, the next step could be the establishment of a gesture pedagogy for this context, based on empirical findings, that can be taught to prospective instrumental teachers at a university level and hopefully contribute to enhance teaching efficiency. This should constitute a major focus of future investigations that could also approach such study by viewing the data from students' perspectives, using and extending the framework presented here to instrumental tuition in other musical instruments (including vocal teaching), and expanded to small and large group ensembles.

This investigation is limited due to the small sample of teachers and students. In addition, only the first 3 minutes of each teaching session were analysed. It should also be stressed that the teacher population in this study was comprised of experienced individuals and as such more research is required to understand what teaching differences there may between novices and experienced teachers. Furthermore, students' proficiency levels ranged from Pre-grade 1 to Grade 8 and it is possible that teaching more advanced piano players would generate alternative results. These findings are particular to the Western classical music tradition and considerations about other musical cultures need to account for contextual specificities.

4.4.4 Conclusion

The results of this study suggest a relationship between the didactic intention of the teacher and the forms of gesture they employ to communicate information to the student. Such a relationship manifests through: a statistically significant difference in teachers' combined gestural performance across students proficiency levels (with the exception of Musical Beats and Playing Piano gestures); a tendency of higher gestural production of certain gesture types for certain student proficiency levels, consistent with most of the teachers' individual results (exception for Playing Piano and Musical Beats gestures); and qualitative differences in the use of Deictic and Touch gestures according to student proficiency levels.

The agreement reported between teachers in relation to student experience levels suggest a gestural scaffolding approach in the piano teaching context in which teachers are sensitive to piano-learners' conceptual levels and vary their gestural approaches in accordance to student skill levels. It is through this scaffolding process that the encoding of musical communication (through verbal and gestural signs) and interpretative meaning construction is developed. Further research is needed for understanding this eclectic and ecological lexicon in development which can help explain the meaningful relationship between teaching/learning experiences in a music instrumental environment.

Chapter 5

Gesture in piano learning

> We should not deplore the pianist's dependence on the body, but celebrate it: music is not limited to sentiment or to the intellect, to emotional commitment or to the critical sense, but engages, at the moment of performance, the whole being.
>
> (Rosen, 2002:61)

In this (and the subsequent) chapter, I shift my focus of enquiry from *gestures used by teachers while teaching*, towards an understanding of *how teachers' gestures* can impact student learning. I begin by considering the ways in which gesture mediates piano learning (Section 5.1), particularly in relation to the creation of musical meaning (5.1.1.), generation of music mental representations (5.1.2), role in fluency and expression (5.1.3), and mechanisms through which goal-directed actions can result in learning (5.1.4). I then reflect upon the relationship between gesture and learning by invoking a range of relevant multidisciplinary considerations. The chapter concludes with a summary and discussion, which aim to pinpoint and justify the subsequent research avenue I have taken in this work.

5.1 Gesture mediating piano learning

Without a bodily interface, the human experience of engaging with music – through learning, listening, performing and teaching – would be impossible. Yet the role of the body as one of our primary means of 'knowing' has been persistently overlooked in instrumental music teaching practices. Several interrelated factors can be explored as a means to address this neglect. Firstly, the emphasis placed upon musical notation at the earliest stages of learning (mainly the focus on pitch and rhytmical elements) has been argued as leading to decreased aural and bodily sensitivity to the natural unified patterns that children spontaneously observe when playing music (McPherson & Gabrielsson, 2002; Mills & McPherson, 2006). Secondly, instrumental and vocal pedagogy mostly relies upon subjective and vague perceptions of what works best in the personal experience of certain teachers and pedagogues, instead of an understanding of principles that can contribute to optimised learning. This is evident in the contradiction between the embodiment paradigm as providing a solid platform for helping to understand musical performance processes (e.g. Le Guin, 2006; Leman, 2010), alongside the well-documented high rates of vocational physical career injury among musicians (Fishbein, Middlestadt, Ottati, Straus & Ellis, 1988; Visentin et al., 2008). Thus, although musical performance is essentially and integrally embodied, such embodiment is not always based on efficient and healthy movement principles. And, thirdly, the training of music educators tends to be highly focused on content and curriculum, rather than on the development of musical interactive styles that can promote efficient learning (Young, 2005). Consequently, it is perhaps unsurprising that teachers tend to either follow a teaching practice based upon how they were taught as students, or to develop their own idiosyncratic teaching methodologies

(Hallam, 1998; Kennell, 2002; Philpott, 2001; Young, Burwell, & Pickup, 2003; Zhukov, 2004). All of this contributes to a general misunderstanding of the dually conceptual *and physical* nature of teaching and learning to play musical instruments – which is contradictory to current educational trends in music education more generally, which put forward a decisive relationship between gesture, body movements and music learning.

Some recent empirical evidence has also emerged which acknowledges the role of the body (and its movement through actions and gestures) in processes of learning in not only subjects of high-frequency gestural and motor activity (e.g. music and sports), but also in subjects with more abstract natures such as physics and mathematics. In music, these ideas were first explored by music educators such as Dalcroze (1865-1950), Orff (1895-1982), and Kodaly (1882-1967) who established different methods and approaches for including gesture and body movement into music education (for more details see Chapter 2, section: 2.2.3). A relation between gesture and learning music was confirmed and extended by the work of Cohen (1997). Focusing upon studying the musical creativity of young children in nursery settings, she argued that cognition has its roots in kinaesthetic gestures, which act as a pedagogic tool capable of transforming the mind's musical developmental process. In this argument the French phenomenologist Merleau-Ponty's (1945) theory of embodiment is echoed in the idea that knowledge is generated through the perception and experience of an individual in his/her world and received through body senses, residing not only in the mind but also the body. Over the last thirty years, such ideas have decisively shaped and influenced debates within cognitive sciences (e.g. Johnson, 1987; Lakoff & Johnson, 1980, 1999; Varela, Thompson & Rosch, 1993) and arts education (e.g. Bowman, 2000; Rouhiainen, 2003; Sheets-Johnstone, 1981, 1999). And thus, a strong emphasis has been placed upon action and knowing-through-action in general musical education (see Bowman, 2000; Elliott, 1996; Gruhn & Regelski, 2006; Regelski, 1996, 1998). This was felt particularly strongly following persuasive arguments put forward by scholars in human development psychology which suggested that the body, with its dynamic moving properties, is the foundation for all cognition and development processes (Bruner, 1966; Piaget, 1936, 1970, 1971; Vygotsky, 1966). What is implied in the above ideas is that the nature and structure of our mental activities derive from real and imagined physical actions, and thus that learning is a consequence of our bodily interactions with the world, in which actions can eventually be internalised as thought. That said, the role of gesture in music goes beyond sound production and the perception of music (Davidson, 2009): gestures operate simultaneously with individual and communicative functions, implying that they work as mediators between the mind and the body's physical environment (Leman, 2010). Hence gestures assume a crucial role in mediating learning processes.

As a mediator of learning, gesture has been approached in different ways by different strands of musical research. In musicological writings gesture has often been approached through a narrative account based upon descriptions of subjective experiences (e.g. Corness, 2008; Haviland, 2007, 2011; Juntunen & Hyvönen, 2004; Woodard, 2009). Although these experiences provide relevant insights in philosophical terms, they lack an understanding of gesture as a "causal physical and biological phenomenon that is connected with the experience" (Leman, 2010: 126). In contemporary music psychology and music theory, a heavy emphasis has been placed upon understanding cognitive aspects (mostly regarding mental abstract processing) in musical experiences. Such emphasis is shifting towards an appreciation of the role of the body in such cognitive processes, and examples of such a shift include explanations of experiences of rhythmic and tonal structures in music as intrinsically connected to human bodily experiences – in the form of bodily image-schemas (Brower, 2000; Cox, 2001; Larson, 1997; Zbikowski, 1997). In two important instances of this, Shove and Repp (1995) and Friberg and Sundberg (1999) explain that the timing in musical phrases is closely related to human motor activities, and yet more recent research concerned with applying experientialist ideas to musical meaning (based on the work of Lakoff and Johnson, 1999) claim that cognition is shaped by aspects of the body (see Brower, 2000; Zbikowski, 2002). Such findings are suggestive of the importance of studying physical aspects involved in musical performances – not to mention learning and teaching – in relation to the creation of musical meaning/s. However, the problem of these experientialist approaches (e.g. Brower, 2000; Zbikowski, 2002) is that they often dissociate themselves from a social interaction perspective and attribute different levels of emphasis to 'mental versus body' aspects. One revealing example is the work of Zbikowski (2002: 273) which claims that musical knowledge involves a cerebral and abstract "network of information" which is generated through the conceptualisation of body knowledge into abstract mental models. This model is acutely focused upon internal cognitive structures, leading the author to conclude that music is a "para-linguistic medium" (*ibid*.: 295). Although a human body-based approach to studying musical activity is offered here, the structural, information-based model of communication alongside the claimed "para-linguistic" nature of music, without a parallel "para-gestural" medium, does not allow Zbikowski (2002) to explore further subtleties of human interaction in time (Moran, 2007). Drawing upon the work of Margolis (1987) and Johnson (1987), Brower (2000: 324) takes a different approach by arguing that musical meaning occurs as a result of a process of mapping or linking heard patterns of a musical work onto three different lawyers of representations patterns: those related to the musical work in itself ("intra-opus patterns"); those abstracted from musical conventions ("musical schemas"); and those related and extracted from human bodily experience ("image schemas"). This notion resonates with work on rhythmical musical perception in which body-based models of musical performance have been proposed, suggesting a link between human locomotion and timing in music performance (e.g. Friberg et al., 2000; Kronman & Sundberg, 1987; Shove & Repp, 1995; Todd, 1995). Thus, musical cognition cannot be dissociated from human bodily action.

Research dedicated to learning to play a musical instrument has changed and developed considerably over the past two decades, becoming increasingly occupied with finding the most efficient and effective ways to acquire and develop musical expertise; yet links between gesture and learning in the instrumental music teaching context have not been thoroughly considered. The deep influence of cognitive theory in research in music psychology and education (for a review see Clarke et al., 2010) has, of course, emphasised attempts to understand the various cognitive, emotional, and environmental influences upon the development and acquisition of musical skills. Besides emphasising that learning to play a musical instrument is a complicated and challenging process, this trend of research has shown that the process of learning to play a musical instrument is shaped by a multitude of factors pertaining to individuals, their environments, and their cultural situ – all of which continually interact and overlap. In attempts to study this matrix of factors, an array of different instrumental learning aspects has been debated. These aspects range from: identifying factors that can predict 'success' in learning such as the role of genetics and environmental impact upon musical skill development (for reviews see (Hallam, 2006; McPherson & Hallam, 2009); how musical learning and development of musical expertise affects the brain (for a review see Hodges & Gruhn, 2012); practical aspects such as learning to read and memorise musical notation (essentially within the premises of the western musical classical tradition) (for a review see Mills & McPherson, 2006); and stages of becoming a musician (e.g. Ericsson & Smith, 1991; Harnischmacher, 1997; Manturzewska, 1990; Papageorgi et al., 2010; Sosniak, 1985). However, the acknowledgement that learning to play a musical instrument is a demanding and complex process which is shaped by individual, environmental and cultural factors, needs to be complemented by the fact that it simultaneously entails the embodiment of abstract concepts at different levels: physical, mental and emotional – and all through cognitive and perceptual-motor processes. In terms of process, it requires the integration of multimodal sensory (touch, proprioception and vision) and motor information that is monitored through auditory feedback (Conde, Altenmüller, Villringer & Ragert, 2012), in addition to the interaction of several memory systems (Chaffin, Logan, & Begosh, 2009). Working from this layered definition, it is evident that learning to play a musical instrument is a dynamically sophisticated, multifaceted, and embodied process, and one that needs to be considered from a gestural and motor skill learning perspective whilst accounting for observational and imitational processes. A deeper knowledge of gestures' role for the formation of musical meaning (5.1.1), generation of musical mental representations (5.1.2), role in fluency and musical expression (5.1.3) and role in the mediation of goal-directed actions (5.1.4) can provide insights towards the salient gestural aspects embedded in the learning process. Taking into account that such greater detail can inform research directions quite significantly, this endeavour is undertaken in the following sub-sections.

5.1.1 The relationship between gesture, learning and musical meaning

Gesture is a ubiquitous element in our experience of mediating with both ourselves and our environment; it is thus an essential channel in the generation of musical meaning (Cumming, 2000; Hatten, 1994; Leman, 2010). Leman (2010: 128) argues that "the first step of meaning formation may be seen in terms of processes that account for the transformation of sonic features into the presence of sensory qualities and motor action-related features". Terming this process "synaesthetic" or "kinaesthetic", Leman describes it as follows:

> During synaesthetic transformation, physical properties of musical sound such as frequency, duration, spectral density, loudness are first perceived as auditory categories (such as pitch, duration, timbre and volume). Via multisensory integration they become related to impressions of space, visual and tactile nature, such as extension, density, weight, smoothness, roughness, softness, liquidness, etc. (Leman, 2010: 128)

Also further developing into musical meaning generation, Leman (2010: 128) adds another layer into this process, one that follows from "synaesthetic" and "kinaesthetic" levels and which he calls "cenaesthetic transformation"[47]. At the level of "cenaesthetic transformation" links are established between conceptualisation and cognition through assumed embodied and conceptualised aspects. In his view, "cenaesthetic" processes are a precondition for a fully symbolised type of meaning

[47] This so-called **'cenaesthetic'** process is also referred to elsewhere as hermeneutic (Hatten, 2003) or semiotic process (Tarasti, 2003).

formation, one in which felt properties or descriptions become linked with cultural symbols and topics. In the process of music making, whilst physical movement is considered to animate mediation between the mind and physical environment, gestures are the vehicles through which such mediation is articulated (Leman, 2010). So although gesture is an integral element in all types of music making experiences, a closer look into "the experience of flow", the "experience of presence", and the "experience of cause-effect" (*ibid.*: 139) can reveal how gestures can impact upon such experiences. The "experience of flow" is characterised by a deep focus on the activity of music playing to such an extent that there are no concerns with elements such as the instrument, the environment, or intrinsic individual aspects – implying an optimum balance between skills and the challenge implied in the activity of musical performance (Csikszentmihalyi, 1990). More specifically, Csikszentmihalyi (1990) talks about a state where all thoughts, concerns and distractions disappear and musicians become fully present in the act of musical performance; Here, the level of expressiveness revealed by gestural performance may not only provide an indication of flow, but gestures could themselves bring about *an experience of flow* (Leman, 2010). The "experience of presence" is the result of embodied interaction, such that the musician has the illusion that the musical instrumental is an extension of his/her own 'self' (and is no longer considered as external). In this experiential level, the instrument is considered as a channel through which the musician can express him/herself in music (see Nijs, Lesaffre & Leman, 2013). Contrary to the depth of the above two experiences, Leman (2010: 141) considers the "experience of cause-effect" in relation to music and gesture as simply "an experience of the cause of a sound from a gestural perspective, rather than a conceptual understanding of the causality of the relationship as such". In these three types of music making experiences it is possible to implicitly realise that there are multiple possible ways of combining gestures, body movements and music. And this leads not only to the common use of the word ‘metaphor’ being applied to music, but also to the use of music as metaphor for movement (Philpott, 2001).

Metaphor “conceptually unites reason and imagination” (Lakoff & Johnson, 1980: 193), and therefore considerations of movement as metaphor are relevant for music education situations “where the sense of the musical meaning is transmitted or illustrated by gesture in order to solve a technical problem or to enliven musical expression” (Juntunen & Hyvönen, 2004: 206). Although the notion of metaphor frequently appears as intrinsically connected to verbal metaphors, Johnson (1987: 7) posits that verbal metaphor is in itself a propositional result of a much more “complex web of connections in our experience”; this is to say that while language may constitute the only way in which it is possible to describe such metaphorical processes, metaphors are not reducible to the verbal or linguistic description. This means that verbal metaphor can relate to one’s own verbal expression of bodily experience and reflect the way in which we naturally think (Wis, 1993: 14) – echoing Merleau-Ponty’s idea that ‘my words’ imply a linguistic expression of corporeal reflexivity (Dillon, 1997: 110–11). Departing from Lakoff and Johnson’s (1980) claims that a metaphor operates as a functional connection between concrete and abstract thinking in general, Juntunen and Hyvönen (2004) transpose this idea to teaching music by arguing that bodily movement is a physical metaphor between musical activities and conceptual thinking. This resonates with Leman’s (2010: 130) claim that gestures can be said to be “neither purely physical, nor purely mental”, and as such can be a crucial element for better understanding how motor and cognitive skills interact during the learning process.

In fact, increasing sources of evidence suggests that perceptual-motor and cognitive skills are acquired in fundamentally similar ways (Rosenbaum, Carlson & Gilmore, 2001), contradicting the traditional terminological division[48] that so deeply influenced the study of skill acquisition of 'motor skills' for movement and 'cognitive skills' for mental processing. Among such supportive evidence for this claim are findings that suggest that though motor skills have been acknowledged as centred in the cerebellum and basal ganglia, and cognition in the prefrontal cortex, both can be activated during certain motor *or* cognitive tasks. For example, the cerebellum was shown to be active during performance of tasks such as word generation (Petersen, Fox, Posner, Mintun & Raichle, 1989), sequence learning (Jenkins, Brooks, Nixon, Frackowiack & Passignham, 1994), tactile discrimination (Gao, Parsons, Bower & Xiong, 1996), and maintenance of information in working memory (Desmond, Gabrielli, Wagner, Binier & Glover, 1997). This shows that the cerebellum plays a role in cognitive as well as perceptual-motor performance (Leiner, Leiner & Dow, 1995). Moreover, transfer specificity (Proteau, Marteniuk & L´evesque, 1992) and generativity (Newell & van Emerick, 1989) – which relate to the use of abstract rules and reflex-like productions – are similar in the two skill domains, and thus it is almost certainly incorrect to say that cognitive skills rely only upon abstract rules (Rosenbaum, Carlson & Gilmore, 2001). Despite the mentioned similarities between cognitive and perceptual-motor skills, some differences have also been identified: 1) Cognitive skills consist of actions that may relate to events that may be remote in time or space and as such have symbolic outcomes; and 2) Perceptual-motor skills have non-symbolic outcomes and seem to consist of actions that relate only to the immediate time and place in which they occur (Rosenbaum,

[48] This division is clearly evidenced in stage-based theories for skill acquisition such as the ones proposed by Fitts and Posner (1967); Anderson (1982); and Gentile (1972, 2000) which strongly impacted the way researchers conceptualised musical development.

Carlson & Gilmore, 2001). As a musician, I find such assumptions difficult to relate to the physical music educational context. Firstly, because physical gestures in the context of human-to-human communication (musical or not) involve motor action and such motor actions (when assuming the form of gestures) can be understood by the gesturer and observer/s as having 'symbolic meaning' (as discussed in Chapter 4). Secondly, when performing a piece of music, the musician's perceptual-motor actions are dependent upon the musical content and the type of sound intended. However, such perceptual-motor actions relate in time to musicians' learning traditions, and the practice type/style they have developed. Thirdly (and finally), many of the perceptual-motor actions developed through musical performance may be symbolic and, at times, may constitute ways of understanding and communicating the musical material and establishing an interaction with the audience.

Ecological psychology[49], dynamic-systems theory[50] and activity theory[51] can provide relevant insights into the above, particularly in relation to how learners develop different ways of perceiving, relating, and interacting with the environment in what has been designated elsewhere as 'maximal adaptation' of the performer to the task, and to the environment (Ericsson & Lehmann, 1996; Gibson, 1966, 1977). Here the learner is acknowledged as part of a dynamic system that comprises learner, tools, environment, and any other individuals related to the task-environment, and

[49] The main concepts of **ecological psychology** have been developed and adapted from the work of Gibson (Gibson, 1966, 1977) and Barker (1968). Put simply, human behaviour is here considered as situated within specific contexts and/or environments, and thus appropriate analysis of the environment is essential for explaining perceptually guided behaviour.

[50] The **dynamic-systems theory** is based on the premise that constraints imposed by our biological heritage (and by similarities in human environments) result in similar developmental outcomes. This theory places emphasis on perceptual-motor development and embodied mind considerations (see Thelen & Smith, 1994; Thelen & Ulrich, 1991; Thelen, 1995).

[51] **Activity theory** considers that human activity is mediated through the environment, culture, person history, motivations, etc. The system goes beyond one individual and encompasses teams and organisations. Its main strength can be considered to be the acknowledgement and consideration of the role of others and culture for human development (see Vygotsky, 1966).

where bodily actions, considered from a view of interacting with the world can be internalised as thought (see Bruner, 1966; Piaget, 1970; Vygotsky, 1966). This implies a biological conditioning for learning through bodily actions that leads to the idea that "the body and its dynamic relationship with the world are a fundamental component of musical literacy at all levels of development and musical cognition" (Philpott, 2001: 80). More specifically, it is assumed that "learning is the development of new skills via goal-oriented attunement to affordances[52] in fields of promoted action" (Abrahamson & Sánchez–García, 2014), and that training 'tunes' the learner to attend to selective elements in the environment that can be relevant for performing a given task (Vilar, Araújo, Davids & Renshaw, 2012). Such an ecological and dynamic view of learning, which blends ecological psychology, dynamic-systems theory and activity theory (including Piagetian/Vygotskian instrumental genesis) has increasingly been pushed forward by scholars from various disciplinary backgrounds, including mathematics and sports (Abrahamson & Sánchez–García, 2014). The turning point leading to such theoretical blending has been the recent acknowledgment that learning is essentially an attempt to solve a motor coordination problem, whether it is in music, sports, or even mathematics; and, moreover, that a teacher's "metaphorical utterance serves to impose environmental constraints on a novice's attempts to accomplish a task" (Abrahamson & Sánchez–García, 2014: 5). Also grounding his argument in activity and enactive theories (such as Kaptelinin & Nardi, 2006; Nardi, 1996; Varela, Thompson & Rosch, 1991), Leman (2010: 127) suggests that approaches to gesture should consider that "music is perceived and performed through gestures" and is "directly

[52] **Affordances** are properties of the environment that support possibilities for action, and in which individual engagement in action is conditional for people's experience, cultural framing, motivation, etc. (Gibson, 1977).

felt and understood through the body, without the need of verbal descriptions". Leman also notes that when viewed from an embodied stance, music cognition can offer a framework for connecting the subjective character of musical experience to physical and biological aspects, which is essential for the musical experience to take place. That said, the challenges posed for teaching and research perspectives are numerous. To begin with, it is difficult to distinguish between bodily movements applied to musical performance that are gestures (i.e. actions that express something) and ones that are not; and this is on top of the lack of empirical grounds upon which to judge gestural teaching and learning practices/methods in relation to efficient learning of specific musical aspects.

5.1.2 The role of gesture in the generation of music mental representations

Experiencing music through musical behaviours (such as gestures and body movement) is the most efficient way to establish mental representations of musical material (e.g. Chaffin, Lisboa, Logan & Begosh, 2010; Chaffin & Logan, 2006; Ginsborg, 2009; Gruhn, 2006). Playing an instrument, singing and moving to music are processes in which essential embodied musical gestures unfold music tonal relations, metric, and beats – constituting a praxial[53] approach to promoting, developing and establishing musical understandings (Gruhn, 2006):

[53] The term **'praxial'** denotes action embedded in and responsive to specific human contexts of effort (Elliott, 1995). This word, firstly used by Aristotle has recently been transposed to music education contexts by authors such as Alperson (1991), Elliot (1995) and Gruhn (2006). Elliot argues that as a concept, *praxis* helps capturing the fact that music involves processes-and-products (actions-and-outcomes) intertwined, in human doing-and-making that is purposeful, contextual and socially-embedded. For more see Elliot (1995).

> The connection between tonal imagery and vocal production is reflected by the phonological loop. Vocal production of a pitch relies on the tonal imagery of that pitch. What is produced by the vocal fold must be aurally controlled and measured against the audiated image until the mentally intended (i.e., imagined) and the orally realised tones are identical. By this, fine motor activity and mental imagination interact in building a fund of mental representations. (Gruhn, 2006: 23)

It is therefore possible to conclude that music learning results from active musical production, and this underscores the importance of practice in which students actively and physically engage in playing their set repertoire, preferentially on a daily basis. The importance of practice goes beyond the simple implementation of ideas, concepts or advice given by teachers during tuition. This is clearly evidenced in a case study involving self-reports of a singer during her 'learning journey' of a musical piece, where the role of kinaesthetic[54] learning in the development of mental representations of music was appointed as crucial (Ginsborg, 2009). The singer in this study, who also acted as the researcher noted that certain gestures were performed at different times during the process of learning the musical repertoire from memory, and considered such gestures helpful for her learning journey:

> Beating a pulse, particularly in the early stages of learning, provides the framework for ensuring rhythmic accuracy. Conducting, during the memorising phase, helps the formation of a metrical representation. Gesture, once the piece is learned and memorised, underpins the communication of semantic meaning (whether musical or verbal). (Ginsborg, 2009: 140)

Gestures similar to the above were performed by piano teachers in the empirical investigation reported in Chapter 3. Teachers were arguably attempting to

[54] The term **Kinaesthetic** is defined as "the sense of muscular effort that accompanies a voluntary motion of the body. Also, the sense or faculty by which such sensations are perceived" (Oxford English Dictionary Online).

teach through their own musical behaviours while demonstrating gestural strategies, strategies that could be mimicked by students to help capture mental representations, and thus possibly result in learning. Further research involving qualitative self-reports of practice has shown that gesture is helpful for memorising music. It appears that expert musicians structure their practice and memory processes around perceived 'performance cues'. These cues allow the musician to be focused upon some aspects of the performance while allowing other aspects to be executed automatically (Chaffin & Logan 2006). Thus performance cues are 'retrieval cues' that extract the knowledge of what comes next from long-term memory and provide the musician with a mental map of the piece in working memory as the performance progresses, enabling soloists to perform challenging works from memory on the concert stage. Chaffin and Logan (2006: 116) have identified four types of performance cues: "structural" – places in the formal structure of the music, where musical material changes; "expressive" – related to the musical emotions being conveyed to the audience (like joy or sadness.); "interpretive" – moments at which aspects of interpretation require closer attention (e.g., a modification of dynamics or tempo); and "basic" – related to critical details of technique or musical structure that are required to be executed in an exact manner for the performance to unfold as intended (e.g., the use of a particular finger or hand). It is not difficult to recognise that gesture is intrinsically involved in each of the aforementioned cues. This is especially the case considering that gesture and motor action are essential for performing the music material. However, what seem to change as performances unfold are performers' foci of attention, which can be consciously placed upon gesture, or at other times upon 'structural' changes of the musical repertoire, 'interpretative' elements, or 'basic' performance cues. That is to say that gestures can be performed at 'conscious' or 'unconscious' levels of awareness, and musicians appear to make decisions in relation to how to guide their focus of attention for performing an intended repertoire, during practice sessions (see Chaffin et al., 2002, 2010; Chaffin & Logan, 2006). Hence all the above musical performance gestures, considered as an integral aspect of performance at conscious or unconscious levels of performers' awareness, have a role to play in both encoding and retrieval processes.

If, however, gesture has a role in terms of the generation of mental representations of musical material, doesn't it then become relevant to ask *how* and in *what* way(s)? In responding to these questions, there are suggestions that our experiences of rhythmic and tonal structures in music are inseparable from our bodily experiences, through bodily image-schemas (Brower, 2000; Cox, 2001; Larson, 1997; Zbikowski, 2002). The assumption offered by Dogantan-Dack (2006: 450) is that "we experience and make sense of musical phenomena by metaphorically mapping the concepts derived from our bodily experience of the physical world onto music"; and it is clear that gesture works as a mediator in such interplay. Focusing on learners' self-perceptions of their learning processes and the ways in which teachers can better 'tune' learners to relevant elements in the task and environment, are absolutely essential building blocks that can provide important insights into the learning process in this context. Ultimately, such a focus needs to not only encompass considerations relating to expert performers (as it does presently), but also needs to be extended to learners at various levels of skill acquisition.

5.1.3 The role of gesture in fluency and expression

A fluent musical performance occurs when an individual has effectively internalised the gestures and actions needed to make music, and has no further need to focus on each gesture (or the action of each body part) in the way that a beginner might (Davidson, 2009). The achievement of such fluency relies upon a holistic process of adaptation aimed at achieving balance between individual and his/her moving body. As Polanyi (1969: 148) puts it: "Every time we make sense of the world, we rely on our tacit[55] knowledge of impacts made by the world on our body and the complex responses of our body to these impacts". Applied to piano playing, this means that as well as applying pressure to the piano keys, the fingers also provide feedback for the performer about his/her own gestural motor movement, and how these affect the musical sound. This reversibility and reciprocity of 'sensing and being sensed' pointed out by Merleau-Ponty (1945), facilitates bodily reflection in which instead of automatically responding to the world, the gesturing body in movement is able to reflect and adjust its own actions (Parviainen, 1998) and achieve balance. Such balance is attained through an ever-evolving knowledge ('bodily knowledge': a term adopted by Parviainen, 1998) that is acquired through observation of our own movements and listening to our kinaesthetic sensations (O'Donovan-Anderson, 1997). So a plethora of processes act and interact as a person performs and learns to perform music; and for such reasons, understanding how motor plans applied to

[55] The term **'tacit knowledge'** was introduced into philosophy by Michael Polanyi in 1958 in reference to the fact that 'we can know more than we can tell'; and such knowledge in many instances cannot be adequately conveyed through verbal means. This type of knowledge only emerges through practice within appropriate contexts and transmitted in co-shared social contexts, commonly called the 'community of practice'. Examples of this type of knowledge include playing a musical instrument, driving a car, riding a bike.

musical performance are organised has posed a considerable challenge to researchers.

Since it was suggested that motor memory representations do not operate for single or individual movements, but rather that they operate for classes of movements (Bernstein, 1967), attempts have been made to theorise that either: the brain has a central executive role for movement control; or that motor systems have the capacity of self-organising (see Dahl, 2004). To date however, neither of these theories has been effectively, empirically proven. From a fluency perspective in musical performance, what appears relevant for musicians is that fluency largely depends upon "generating and embedding these gestural and motor programmes in memory by rehearsal … a lengthy process" (Davidson, 2009: 365). As the learning process unfolds these gestural and motor actions become increasingly automatic – an absolutely necessary ingredient for performance fluency, and such automaticity is one of the major differences between novice and expert players. As Davidson (2009) puts it:

> Experts' performance movements are seemingly effortless and necessarily effortless: in achieving a high degree of automation (unconscious processing) in the action, the expert performer conscious thought is relatively free to deal with moment by moment modifications that may be necessary as the music is performed. The novice, by contrast, requires full conscious attention on the biomechanical activity. (Davidson, 2009: 365)

In the process of instrumental music learning, teachers need to teach students how to use their arms, hands and fingers in economical and musically-oriented ways; and once elementary gestures are mastered, they can become assimilated and form part of the body schema. Then they no longer require the learner's full attention, allowing greater focus on higher level tasks. However, a fluent musical performance is beyond the integral gestural and motor elements of performance, as it should in addition (and through gestural and motor elements) "convey the structure of the music, express emotions, exhibit motor precision, be suggestive of human motion and gesture, and deviate from stylistic expectations in creative and aesthetically pleasing ways" (Juslin, 2003: 290). To achieve all the above performance components, which do not work in isolation, intensive interaction is required between cognitive and action processes – and physical musical behaviours become intrinsically bound to the mental representations, through an intense experiential learning process. Clearly, in such experiential learning process essentially concerned with learning to express music emotionally, structurally and gesturally - instruction, practice and time are key factors.

Contemporary musical performance research defines musical emotion expression in relation to deviations from musical structural features: "Variations in tempo, intensity, timbre and articulation, as well as the variations in pitch, known as 'vibrato', constitute the most important expressive characteristics of performed music" (Dogantan-Dack, 2006: 450). However, musical expression in performance is not only related to the structural features of the musical material. Recently, body-based conceptions of musical phenomena have been appointed to explain variations in the timing of musical phrases, and also in relation to tone production. It is suggested that progressive slowing-down at the end of certain phrases (in musical terms: 'ritardando'), can be seen in relation to being embedded in human life activities such as locomotion, such as a runner decelerating – as with performers' tendency to slow down at phrase endings (Kronman & Sundberg, 1987):

> ...the sequences of impulses we perceive when we walk or run are similar to the regular sequences of tones in moto-rhythmic music. If the music reminds the listener of physical motion, it would be natural to insert a final ritard, as the listener knows from experience that locomotion is usually slowed down before it is arrested. (Kronman & Sundberg, 1987: 58)

Another parallel was also established in relation to the musical phenomena of 'accelerando' (gradual increase in speed) to 'crescendo' (gradually louder) at the beginning, and 'ritardando' (gradual decrease in speed) to 'decrescendo' (gradually slower) generally at the end of specific musical phrases. This normative tempo and intensity variation is used for shaping a musical phrase, as is frequently observed in music performance. Todd (1995) has related it to the human 'internal sense of motion', which is derived from our experience of locomotion. Regarding the expression and production of 'quality' tone production (specifically in relation to piano playing), Pierce (2003, 2007) defines four movement principles which effectively help the performer to achieve 'good tone' qualities through the use of appropriate musical gestures: 'balancing posture', 'grounding body weight', 'releasing shoulder and arm tension', and using 'weight throw' in order to support playing action. In Pierce's work (2003, 2007) the causal relationship between physical gestures and the resultant musical production is overtly implied. Yet, such a causal relationship merits more attention given that, for instance, certain stages of learning might require and produce different levels and types of embodiment realisations.

We might tentatively conclude, therefore, that learning to be fluent and expressive in playing a musical instrument suggests a process of linkage between physical gestures (related to our human experience of moving and sensing the world) and culturally imposed music-mental-representations. Within the holistic limits of the dynamic and multidirectional process occurring between learner, musical material and world, gesture provides opportunities for learners to interact with musical material. Such interactions are the basis for the generation of music-mental-representations and meaning, the achievement of fluency, and of individuals learning to express themselves in a musical, communicative medium and in musically expressive (culturally bound) ways.

5.1.4 Mediation of goal-directed actions

Although the significance of gesture, motor actions, and the role of the body for learning is being increasingly recognised by a widespread body of research, the exact mechanisms at work in such interplay are part of a noteworthy academic debate. The main theoretical differences within this debate reside in the perceived links between perception, cognition and action, and the emphasis placed upon either brain, body or the interplay of the two. A trend of research within music has argued that performers' body movements originate from certain structural musical elements, such as rhythm, melody, harmony and timbre (e.g. Burger, Thompson, Luck, Saarikallio & Toiviainen, 2013; Leman, Desmet, Styns, Van Noorden & Moelants, 2009; Leman & Godoy, 2010; Maes et al., 2014; Toiviainen, Luck & Thompson, 2010); however, recent evidence also suggests that the musical mind is, instead shaped by gestures and movements produced by the human motor system (Maes & Leman, 2013; Manning & Schutz, 2013; Phillips-Silver & Trainor, 2005, 2007; Repp & Knoblich, 2009; Timm, SanMiguel, Saupe & Schröger, 2013). These findings have relevant implications not only in arguing against 'information processing models of perception' [56] (Byrne, 2005; Fodor, 1975; Massaro, 1990; Pylyshyn & Demopoulos, 1986; Young, 2005) but also in revealing the weight that specific teaching and learning methods can have in shaping how individuals perceive and understand music. Resonating with recent views from within ethnomusicology, music sociology, and psychology, these discoveries imply that music can no longer be viewed as a product (in terms of its absolute elements such as pitch, tone, rhythm) or only understood in mental terms (Blacking, 1973; Clayton, 2009; Cross, 2005; Tolbert, 2001). Rather, music results from a musical behaviour as founded on two distinct and interrelated elements: "a human capacity for communication" and an innate human tendency to "mutually entrain our actions" (Clayton, 2009: 40). And considering all of this in combination, it seems cogent to assert that these musical behaviours shape the way people perceive, understand and perform music, as perception and action mechanisms are inextricably intertwined and always exert a mutual influence.

Yet attempts to look more deeply into this behavioural phenomena, based on perception and action mechanisms, have resulted in contradictory suggestions regarding the direction of the flow of information going from either perception to action ('Inverse models') or from action to perception ('Forward models'). In considering information flow from perception to action, Rizzolatti, Fogassi &

[56] The so-called **'cognitive revolution'** in the 1960s brought with it an emphasis on information processing models which considered human mind processes such as memory, attention and thinking in analogy with computer in terms of information storage and processing. Information processing models of perception attempted to explain how a certain input (stimulus) was processed and how it would generate a certain output, which could consist, for example, of a certain behavioural response. It was assumed that from the hearing stage, the musical information would be transformed into mental representations in a syntactic code of meaningful symbols that were processed according to a systematic set of rules, during processing mechanisms at different stages. Bodily actions were considered as mere outcome of formal symbolic manipulations. Hence perception and action were not only separated from each other, but also remained outside of central cognition sphere. Such approach to communication dominated musical psychology in the 1980s, which witnessed an interest in the study of isolated elements of music such as intervals, tones, and harmonic patterns in laboratory settings (for more see Cohen, 2005).

Gallese (2001) suggest that incoming sensory information stimulates the corresponding motor commands, leading to sensory states. In contrast, other research argues for an information flow from action to perception, suggesting that action enables the prediction of the expected sensory outcome of a planned or executed action (Davidson & Wolpert, 2005; Waszak, Cardoso-Leite & Hughes, 2012). The unidirectional flow of information between perception and action, or action perception proposed by these theories, is the main reason for their present decline of popularity as the dynamic coupling between perception and action gains increasingly wide acceptance. The dynamic coupling assumes that links between perception and action are "not only bilateral, but also multidimensional in the ways people interact with their external worlds while influencing motor and sensory processing" (Maes et al., 2014: 2). Given music's dynamic coupling framework, 'common coding theory' (Hommel, Müsseler, Aschersleben & Prinz, 2002; Prinz, 1997) has been appointed by Maes et al., (2014) as a possible framework for understanding action-based effects on auditory perception in musical performance and learning environments; this is including the instrumental music pedagogical setting.

'Common coding theory' suggests that "the planning or execution of an action recruits the same sensory-motor brain areas as the mere perception of the sensory consequences of that action" (Maes et al., 2014: 9). From this standpoint, Maes et al. (2014) also argue that associative learning (see Heyes, 2010), through which actions and sensory states are experienced together repeatedly, can explain how actions and perception become integrated, resulting in musical learning. This happens through the generation of internal models, which contain inverse[57] and

[57] **Inverse components**: in which sensory information activates the motor codes required for producing a certain sensory state (Rizzolatti et al., 2001).

forward[58] components. Based on findings by other researchers, Maes et al., (2014) go on to suggest that these inverse and forward components' processes mediate goal-directed actions, such as the ones required to play a musical instrument (Hommel, 1997; Wolpert, Ghahramani & Jordan, 1995) – in addition to the processing of sensory information coming from the external environment (Halász & Cunnington, 2012). This shaping of the musical mind through physical and motor actions is evident in findings which reveal that studying music and playing instruments not only changes brain structure itself (Bangert & Schlaugh, 2006; Bermudez & Zatorre, 2005; Schlaugh, Forgeard, Zhu, Norton & Winner, 2009), but also alters brain functions more generally (Hodges, Hairston & Burdette, 2005; Zull, 2002). Although neural changes are more pronounced in individuals who started music studies before the age of seven, one study – which compared the brains of young, novice piano students before and (15 months) after piano practice (Hyde et al., 2009) – demonstrated significant alterations as a result of intensive musical practice. There is, however, a need of a more specific definition of what intensive musical practice really is – one that might allow us to theorise whether the reported brain alterations are a result of a practice that involves motor activity only or performance of gestures' that may, through intensive and continuous practice, be in the process of acquiring a symbolic representation status (see Chapter 4). Solutions to such issues hold the potential to affect the ways in which teachers instruct students to play and practise their musical instruments. This might also further illuminate the relationship between motor and gestural behaviours, not to mention processes involving reading, interpreting and performing written music from a musical score. That said, an individual's engagement with music not only involves sensory and motor

[58] **Forward components**: in which the sensory outcomes are predicted from planned actions (Waszak et al., 2012).

components, but also ‘introspection’ (internal states that may include affect, intentions, metacognition) (Barsalou, 2009) and ‘social interaction’, which need both to be incorporated into theories on internal models (Maes et al., 2014).

5.2 Insights about the relationship between gesture and learning from other fields of knowledge

The role of gesture for learning has not only proved relevant for subjects in which it is necessary for abstract concepts to be embodied in motor activity[59] such as architecture, film, drama, dance and music performance, but also for subjects of an abstract nature such as mathematics, grammar and physics (see Goldin-Meadow, 2003; Mittelberg, 2008; Núñez, 2008; Tversky, Heiser, Lee & Daniel, 2009). The majority of investigations have been located within mathematical learning contexts, where findings suggest that gestures assist with the intellectual acquisition of new material. Children who observed gesture while learning mathematics were found to obtain better learning results than children who did not (Church, Ayman-Nolley & Mahootian, 2004; Valenzeno, Alibali & Klatzky, 2003), leading a range of studies to conclude that observing others perform gesture can be beneficial to the learning process (Buccino et al., 2004; Decety, 1999; Mattar & Gribble, 2005). But if observation is helpful for learning, observing and mimicking/imitating teacher’s gestures during the instructional process appears to provide further positive outcomes. Firstly, students who mimicked gestures demonstrated an improved understanding of the instructional content, and were able to obtain correct solutions for the mathematical problems more effectively than the children that did not (Cook

[59] The following are examples of literature emphasising the role of gesture in learning in environments in which the intended learning outcome is motor activity of various sorts: Davidson, 1994; Johnson, 2007; LeBaron & Streeck, 2000; Müller & Kappelhoff, 2011; Murphy, 2005.

& Goldin-Meadow, 2006). Secondly, children who mimicked instructors' gestures were more likely to extract conceptual knowledge from gestures *they produced*, even in the absence of verbal reasoning by the instructor (Goldin-Meadow, Cook & Mitchell, 2009). And finally, a combination of gesture observation versus production resulted in higher stability of learning over time (Cook et al., 2013, 2008, 2010).

During the instructional process, gesture production by learners can occur in both imitative and non-imitative situations. Learners can imitate gestures that have no apparent goal, such as protruding the tongue (Meltzoff & Moore, 1977), or as goal-directed actions such as pressing a button that will result in turning on a light (Bekkering, Wohlschlaeger & Gattis, 2000; Carpenter, Call & Tomasello, 2005). When imitating goal-directed behaviours, it has been demonstrated that children (and people in general) appear to have an understanding of the goals that motivate those specific gestural behaviours. Taking the example above of turning on a light, children appear to know that the imitative model's behaviour is directed at turning on the light. And in the case in which the behavioural strategies given by the model for achieving the intended goal are not working, children and adults can generate new ways for achieving the goal (see Gergely, Bekkering & Király, 2002). Even in the event of misunderstanding the relation between action and intended outcome, imitating the model's actions would still result in turning the light on (the intended outcome).

Imitating behaviours is, however, substantially different from imitating gesture. A maths teacher's gestures can represent a series of consecutive steps that, if followed, can result in finding a correct solution to the mathematical problem in question; nevertheless, these gestures do not constitute the steps themselves. Solving the actual problem entails not only reproducing teacher's gestures, but also understanding what such gestures represent. Repeating such gestures might consequently lead to learning (Cook & Goldin-Meadow, 2006). In other words, gestures contribute to the mathematical learning context in a cyclical process of learner-reception, imitation, and *adaptation*. Yet gesture carries more learning relation than merely its own immediate effects on learning: gestures performed by children at transitional stages in acquiring a task convey information that is not found in their speech, and reflect their knowledge of the task (Church & Goldin-Meadow, 1986; Pine, Lufkin & Messer, 2004). In addition, children who gesture while learning a new task have been shown to be more able to retain the new knowledge, in comparison with children who did not gesture during the learning process (Alibali & Goldin-Meadow, 1993). Further still, whilst gesture can reflect children's readiness to learn and their knowledge about a particular task, it can also play a role in the creation of new knowledge (Cook & Goldin-Meadow, 2006). This was demonstrated by exposing children to gesture while expecting them to produce other gestures of their own, and examining the relationship between children's own gestural production and learning. Children who produced gestures of their own in instruction presented better results on a post-test than children who, during instruction, expressed the correct strategy in speech alone or did not express the strategy at all (Cook & Goldin-Meadow, 2006). The above study also shows that gestures produced by children during instructions had a much stronger effect on learning than words while supporting the notion that gesturing should be encouraged during the learning process.

Another noteworthy finding in Cook and Goldin-Meadow's (2006) study is that children were more prone to present a gesture evidencing a correct problem-solving strategy when merely observing the gesturing teacher, rather than when explicitly asked to copy the teacher's gestures. An explanation for this could reside in the fact that in explicitly focusing on copying a teacher's gestures, the focus of attention is placed on the gesture and body movement in itself ('internal focus') – thereby moving attention away from the problem and intended solving strategy ('external focus'). Indeed, research in motor learning suggests that directing learners' attention to their body movements tends to disrupt learners' performance on a given task, particularly in the case of more skilled learners (Wulf, 2007). This may be due to the fact that in the process of observing gestures there is in itself an exploitation of the motor simulations in an automatic process that impacts the way people gain information from such gestures (Cook & Tanenhaus, 2009). Thus, the automatic process of gestural and motor observation in itself appears to be relevant for depicting information from gesture. And given its automaticity in gleaning information, different levels of consciousness and gestural awareness could imply different gestural perception outcomes.

Although the focus of this thesis is on gesture, it is important to note that in terms of motor learning there are some links that can be established between the learning and teaching of musical instruments and sports research, particularly in issues such as the training of psychomotor skills, physiology and attentional focus. In sports learning, dynamic-systems and ecological psychology have increasingly dominated the research scene, resulting in the learning of physical activities to be considered as: "the formation of a different dynamical equilibrium, a systemic reconfiguration that emerges in the form of new coordination patterns that satisfy the evolving task constraints [...in which] adaptation is viewed systemically as part of developing an ever expanding situated skill" (Abrahamson & Sánchez–García, 2014:9; Also see Araújo, Davids, Chow, Passos & Raab, 2009; Clancey, 2008). In this line of thought (built upon Gibson's 1977 work on ecological psychology), learners' learning processes are considered as an adaptative behaviour that involves learning actions that are themselves governed by systematic constraints that pertain to 'organism', 'environment' and 'task' (Newell, 1986). Moreover, '*task constraints'* include not only the goals of the action but also socially agreed rules (Newell 1986, 1996). Motor learning has enjoyed widespread attention within sports science, mostly in the context of laboratory experimental research; and so far, attempting to transfer laboratory-based motor-learning principles to music performance has generated more questions than answers (Silli, 2009: 68). It might even be the case that "in some sense, music is 'between' sports and mathematics, because its performance is explicitly embodied, as in sports, and yet its product is immaterial structure, as in mathematics" (Abrahamson & Sánchez–García, 2014: 21). The fact is that despite the commonalities between these two areas of skilled practice (i.e. sports and music), there are still methodological specifics that need to be taken into account in the study designs (Schmidt, 2009) so that findings can be meaningfully applied to each of these two areas of knowledge. Nevertheless, areas of study such as: 'blocked versus random practice'; 'cuing'; 'attentional and motivational influences'; 'mental representations'; 'augmented feedback'; 'continuous and concurrent feedback'; and 'subjective estimation' are highly relevant to the daily practice of both musicians and sports persons. Thus, the potential for music teaching practice to take note of knowledge from sports research concerning the aforementioned issues opens new pathways for empirical evaluation of prevalent 'traditional' music teaching and learning approaches, in terms of optimising student performance outcomes.

5.2.1 How gesture helps learning: proposed mechanisms

Knowing that gesture helps learning has obviously prompted the questions of *why* and *how* gesture might help to promote and achieve learning outcomes; and a number of possible explanations have been offered in response. Given its motion character, gesture is not only appointed as a prime target of visual attention, but its visuospatial character also contributes for it to be able to highlight different aspects of problems or situations that cannot be effectively conveyed through speech alone. In this line of thought it is argued that gesture helps in maintaining the focus of attention in the crucial components of a problem-solving strategy, whilst also providing an embodied representation of possible solutions. In terms of how such embodied representations may help learning, links have been found between the processing of embodied representations and cognitive processes such as linguistic processing (Glenberg & Robertson, 2000; Richardson, Spivey, Barsalou & McRae, 2003), working memory (Wilson, 2001), action memory (Engelkamp, 1998; Nilsson et al., 2000), and mental imagery (Jeannerod, 1995; Kosslyn, 1994). Therefore, gesture may act on learning through exerting influence on all the above aspects (working memory, action memory, mental imagery) in isolation or combination. With regards to influence in memory findings, these suggest that gesture production contributes to a load reduction in working memory systems – enabling people to remember more when they gesture than when they do not gesture (e.g. Goldin-Meadow et al., 2001; Wagner, Nusbaum & Goldin-Meadow, 2004). In addition, there are also relevant effects in terms of online memory (i.e. processes bonded to the storage of new representations) where it is emphasised that performing an action results in better memory of that action (see Engelkamp & Zimmer, 1984). Gesture observation and production can also generate representations based on the mental image provoked by – and associated with – the gesture, and perhaps unsurprisingly, mental representations underpinned by verbal and imagistic elements have been shown to be more easily maintained and retained in memory (Alibali et al., 2000; Clark & Paivio, 1991; Kita & Özyürek, 2003). Put simply, gesture helps learning by making use of its motion character through which it becomes a prime target of visual attention; through this, gesture provides mental imagery in embodied forms of representation that can produce different effects on memory, perception, cognition and, consequently, meaning representations. Yet there is more to this.

Gesture is also an integral and ubiquitous element that reflects individual and social aspects of human behaviour communication – both involving intersubjectivity and communicative processes, which are vital aspects for successful learning processes. Firstly, in terms of individual aspects gestures are crucial for constructing and maintaining intersubjectivity, particularly in educational settings where the goals often include conveying new ideas. And by supporting speech production and self-oriented functions, gesture supports, promotes and enables intersubjectivity (Nathan & Alibali, 2011). Secondly, in social terms gestures have a role in the human interaction by guiding listeners' attention, conveying substantive information, managing social interactions and emphasising certain aspects in the conversation (Alibali, Nathan & Fujimori, 2011). They are also used for grounding abstract ideas through invoking concrete referents; these can be physical or enacted simulations (e.g. Alibali & Nathan, 2006; Hostetter & Alibali, 2008). Moreover, it is documented that gesture occurs more frequently when people pose questions and show a lack of comprehension at early stages of learning and when faced with content of a higher abstract nature (Alibali & Nathan, 2006). Regardless of the mechanisms in which gesture results in improved learning, it is apparent that gesture is a helpful tool for use in instruction: it is not only relevant for individual and social aspects of intersubjectivity, but is crucial for communication, and it encourages children to produce gestures of their own – a crucial practice shown to stimulate the generation of new knowledge.

5.3 Summary and points of departure

The above review has demonstrated that gestures and learning are pervasive elements of human behaviour, and both relate intimately to broad processes of communication, conceptual thinking, and the social practices of everyday life. Despite highly suggestive evidence regarding the importance of gesture for learning processes, which has amounted with particular acuity over the past twenty years or so within music research and beyond, the extent to which relevant insights were effectively applied by the music academic environment is questionable. Firstly, the extent to which the primacy of the musical score and a conception of musical experience in almost exclusive mental terms (in western classic music tradition) has given way to "a reconceptualisation of music as truly embedded in a human bodily experience" is debateable (Dogantan-Dack, 2011: 246). This is clearly evident not only in musicological practice, but also in the strand of research dedicated to studying musical expression. Here the primacy of the musical score still dominates dialogue, as musical expression is persistently viewed in relation to deviations from a predefined musical score (Dogantan-Dack, 2006) – and also in terms of "what exactly a performer 'adds' to a written piece of music" (Juslin, 2003: 280). This is the case at the expense of considerations of the role of the body as 'bringing music to life', and as generator of musical expression in its own terms. And finally, there remains a lack of research into how the physicality of music making contributes to the creation of musical meaning (Dogantan-Dack, 2011), particularly in the instrumental music teaching and learning context, and, certainly in terms of meaning considerations, the specificities of different contexts assume primordial importance.

Indeed, although gesture has been shown to aid and support learning in a variety of learning contexts, there are striking differences between, say, mathematical and instrumental music teaching. While the former generally focuses upon teaching and explaining abstract concepts, in the latter abstract conceptual thinking and motor activity are simultaneously involved. Thus the learning outcomes not only relate to the understanding of abstract concepts (learning to read music, for instance), but also to the physical and emotional application, expression, and performance of such concepts (through performance) in real-time situations. Here gestures are not only ubiquitous in teacher-student communication, but are also essential for teaching and learning to perform, with observation and imitation as key elements in the process. Yet despite the widespread use of teachers' gestural demonstrations and students' imitation of teachers' gestures in the instrumental music pedagogical environment, it is as yet unproven whether such demonstrations exert any influence upon student learning in this context. And if gestures used by learners do play a significant role in learner application and ability-acquisition, questions of teacher optimisation and student learning efficiency surely merit attention. In particular, greater attention should be devoted to the perception and cognition of movement in the gestural processes of demonstration. While relevant groundwork has been done at this level in fields of study such as sports research, physical education, rehabilitation research, neurology, and social cognitive neuroscience (as further demonstrated in the next chapter), it has yet to be undertaken in relation to the instrumental learning setting.

In addition, it is therefore apparent that without a deeper knowledge about how certain teaching strategies can impact upon learning, it becomes difficult to evaluate, improve and systematise teaching in a way that could be evaluated, and to attribute its due share in the process. A lack of research focused on student learning outcomes seems likely to be culpable for the fact that instrumental and vocal pedagogy still remain largely tied to eighteenth and nineteenth-century teaching principles, which almost entirely rely upon subjective and vague perceptions of what works in the personal experience of certain teachers and pedagogues, instead of an understanding of empirical principles that can contribute toward optimised teaching and learning.

Whilst some appear cautious to focus on performance achievement as an indicator of learning outcomes, and are opposed to 'removing' learners from their everyday life learning situations (i.e. O'Neill, 2012), a case needs to be made against focusing solely on subjective understandings of learning processes. If focusing on the optimal learning conditions through rigorous, systematic research perpetuated a simplistic notion that we can become better learners or better teachers (O'Neill, 2012), then, by extension, focusing only on participatory learning and transformation processes can only grant knowledge about specific learning situations within specific contexts, for specific individuals. Contributing to the present state of affairs is also the fact that research focused on learning in the instrumental music context mostly based its assumptions on students' or judges' ratings, rather than on student-specific learning outcomes – hence the present lack of empirical knowledge about this matter. Furthermore, preconceived notions of what musical creativity is (or is meant to be) appear to conflict with the role of imitation in the process of children's instrumental music learning, when it should be clear that this context in itself constitutes a process of musical socialisation for which imitation *is* an important pillar (e.g., Bandura, 1977). Finally, in the midst of a rich variety of approaches to study learning from varied theoretical and methodological perspectives, a need to bridge and combine knowledge from different study areas to the grounds of instrumental music education is painfully apparent. The present research literature, coming as it does from several different standpoints, provides openings for a number of different empirical research pathways germane to this study; so too does it provide justification for focusing on the role of teachers' gestural demonstrations for students learning outcomes.

Chapter 6

Observing and imitating instrumental music teaching gestures

Building upon an opening critique of extant research relating to the learning processes involved in the role of gesture in learning, this chapter explores the relationship between gestural teaching-demonstration and student observation and imitation. This relationship is analysed against student learning outcomes from various learning environments in which demonstration is a frequently used teaching strategy: such as sports, physical rehabilitation and instrumental music education (Section 6.1). Drawing upon three important and interrelated factors at play in learning through demonstration in this context, namely the roles of observation (Section 6.1.1), imitation (Section 6.1.2) and the relationship between auditory and motor learning processes (Section 6.1.3), the importance of studying this topic in this context is demonstrated. Following on from this discussion, I report upon the results of an experiment I have conducted into the effects of student observation and imitation of a teacher gestural demonstration using Mimic gesture in relation to students' staccato[60] performances over time (Section 6.2). I conclude through a reflective discussion of my findings and the resulting implications that these results might pose. This chapter provides an important contribution to literature in music psychology and education by addressing context-specific problems such as: the sparsity of empirical research in the instrumental music environment that evaluates student-specific learning outcomes (student learning here is evaluated in terms of knowledge retention and transfer, in accordance with the requisites of conceptual educational literature[61]); and the absence of empirical research dedicated to investigating the role of gesture in piano pedagogy, particularly regarding the effects of teachers' gestural demonstration and students' learning effectiveness as a result of observation and imitation of teachers' demonstrations.

6.1 Learning through teacher's demonstrations

In the instrumental music context teachers' demonstrations are considered as an integral aspect of learning and teaching (Kohut, 1985; Radocy & Boyle, 1997) and are acknowledged as teachers' preferred teaching strategies, aimed at providing the student with a 'mental template' for either motoric and/or auditory aspects involved in playing the musical instrument (Zhukov, 2004). However, despite empirical evidence suggestive of a highly beneficial role for learning as a result of demonstrations

[60] **Staccato** refers to a particular type of sound articulation in which successive tones are separated by a silence gap and are also short in duration (Repp, 1998).

[61] For detailed information about evaluating learning see Magill, R. (2007). *Motor learning and control, concepts and applications*. McGraw Hill Education.

in contexts such as sports (Bandura, 1986; Magill, 2007; Mattar & Gribble, 2005; Scully & Newell, 1985), there remains a lack of empirical knowledge regarding levels of effectiveness and specific conditions in which it may promote learning. In addition, in the instrumental music teaching context there is still a long way to go as there is a distinct lack of empirical evidence regarding the effectiveness of gestural demonstrations for student learning. This is a result from the fact that most research dedicated to studying instrumental music teacher demonstrations have based their findings on judges rating students' performances, rather than accurate testing of students' retention and knowledge transfer (e.g. Baxter & Stauffer, 1988; Goolsby, 1997; Rosenthal, 1984; Sang, 1987; Siebenaler, 1997). As such, most of the positive beliefs held in relation to demonstration stem from personal views and experiences in association with certain teaching strategies. Nevertheless, it is argued that demonstrations facilitate faster learning (in opposition to verbal only directives), particularly in aspects such as adequate body posture and grasping characteristics of a certain motion (Zhukov, 2004). Although this is in agreement with sports and physical rehabilitation research whose research methods are mostly experimental (e.g. see Magill, 2007) there is a stark contrast between the study methods employed in these fields of knowledge and the ones used in the instrumental music teaching and learning context - where findings are essentially based in qualitative research practices.

Yet, despite the fact that demonstrations are considered as an integral aspect of learning and teaching instrumental music (Kohut, 1985; Radocy & Boyle, 1997), the imitational aspect intrinsically related to learning through demonstration has also been met with a certain levels of opposition by a few professionals. The argument raised by these professionals considers a possible conflict between imitational teaching and student development of interpretative meaning-construction (Rodrigues,

Rodrigues & Correia, 2009) casting further doubts about what teaching methods should be selected in pursuing students' learning effectiveness. In terms of how instrumental music teachers use demonstration in the classroom, teachers were found to demonstrate more when teaching beginners as opposed to more advanced students, and demonstrations occurred more frequently in the first stages of student engagement with the music repertoire (Zhukov, 2004). The fact that experienced teachers use demonstration more frequently than novice or student teachers emphasises the need for a teachers' teaching preparation that addresses theoretical and practical teaching aspects relatively equally. But in order for such a situation to materialise, research needs to ascertain how teachers' gestural behaviour might be optimised in relation to student learning outcomes and questions that need to be asked include: what type of demonstrations are effective? When is their effectiveness maximised? And how might that be demonstrated?

In sports and physical rehabilitation a study reviewing instruction in sports questioned some of the popular beliefs regarding the use of demonstrations in the coaching of soccer (Williams & Hodges, 2005). Through such review William and Hodges (2005) concluded that demonstrations should be used only after an informed judgement about the usefulness of such teaching strategy versus others forms of providing information about skill performance. Meanwhile, it has been suggested elsewhere that decisions about the use of demonstration need to ponder what a person actually 'sees' when a skill is demonstrated, rather than 'looks at', considering that what we see is "what we perceive from what we look at" (Magill, 2007: 309). This implies that simply 'looking' at something does not warrant enough assurances regarding the processes of 'perceiving' and 'learning'. Thus, teachers and coaches alike need to ensure that learners are focusing their attentional resources (including visual) on aspects of the task that may promote learning. Similarly, it becomes relevant to have in mind that what a person perceives may not necessarily be something that he or she specifically looks at (or looks for), and to take into account that what we perceive may be at a conscious or unconscious level of awareness (Magill, 2007). Hence it is common for people asked to describe what they saw in a given demonstration to not always be able to provide an accurate account of that demonstration.

Where abstract concepts need to be embodied and physically performed, teachers' demonstrations provide students with an understanding of the movement-to-be-performed in terms of trajectory, direction, amplitude, intensity – and in instrumental music education the sound or tone quality intended from such movement. Amongst the variety of gestures performed by teachers in the instrumental music teaching and learning context, Mimic gestures can be particularly useful in providing the aforementioned movement types. I define these (in Chapter 3) as instances where teachers appear to mimic a certain mental image of a gesture that they consider appropriate to perform a particular sound producing action while expecting the student to imitate the gesture shown. The usefulness of 'mimesis and imitation' for learning may reside in the important roles they are said to have had in human evolution and the development of intersubjectivity (e.g. Itkonen, 2008; Tolbert, 2001; Zlatev, 2008). Nonetheless, such usefulness from a teaching and learning perspective needs to be questioned and deeper consideration given to the processes of observation and imitation in educational settings. In particular, greater attention should be devoted to the perception and cognition of movement in the gestural processes of demonstration. While relevant groundwork has been done at this level particularly in sports research, physical education and educational research (particularly in relation to maths learning) (see Cook, Press, Dickinson & Heyes, 2010; Cook et al., 2013;

Goldin-Meadow et al., 2009; Magill, 2007; Mornell, 2009), it has yet to be undertaken in relation to instrumental learning settings. This is the case because motor skill acquisition is an essential aspect of learning in this context and so it seems pertinent to extend rigorous academic attention to this pedagogical arena in addition to analysing the influence that specific teaching strategies can have on students' learning outcomes. It is therefore apparent that without a deeper knowledge about how certain teaching strategies can impact upon learning, it becomes difficult to evaluate, improve and systematise teaching in a way that could be evaluated, and to attribute its due share in the process.

Terminologically speaking, the terms 'demonstration' and 'modelling' have been used variously and inconsistently across a range of conceptual approaches, including motor learning research, instructional research, music psychology, and music education (see Chapter 3, Section 3.1.3). For such reasons I devised (in Chapter 3) a differentiation between the terms 'demonstration' and 'modelling', in which 'demonstration' was defined as: instances where teachers show the student how a particular action should be performed, without actively engaging the student in the action and in which the student was mostly listening and observing; and 'modelling' as instances where teachers actively engaged the student in performing actions alongside teachers' explanations. The importance of this differentiation resides on the distinction it makes between 'seeing an action being performed' and 'seeing and executing an action', this way enabling further consideration into how particular teaching strategies can affect student learning.

6.1.1 Learning through observation

Through vision, people obtain crucial information that guide and influence the way they move in and through their environments and how they coordinate their bodily movements. Such information relates not only to the perception of other people, environment and objects but also includes relevant inputs related to motions involved in eye-hand coordination and essential data for undergoing movement corrections, through the feedback received (Magill, 2007: 130). Differences regarding neural pathways of central versus peripheral visual fields led researchers to conclude that the visual system is composed of two distinct anatomical systems that operate in parallel called[62] 'vision-for-perception' and 'vision-for-action' systems[63].

Interestingly, although we are generally conscious of information detected by the 'vision-for-perception' system, our awareness of information obtained through the 'vision for action' system (and the mechanisms through which a person translates the perceived information into action) is largely unconscious and not yet fully understood. Nevertheless, explanations have been proposed, and the two most influential attempts are the *cognitive mediation theory* (Bandura, 1986) and the *dynamic view of modelling* (Gibson, 1966, 1977; Scully & Newell, 1985). The former suggests that when a person observes a model there is a translation of the observed movement information into a symbolic memory code, so that the brain can rehearse and organise information. To perform the skill the person accesses the memory representation and

[62]Although several theories have been proposed regarding role specificity of these two anatomical systems, theoretical differences are mostly terminological rather than conceptual (i.e. Kinectic and static visual system by Paillard, 1980; focal visual system and peripheral vision by Trevarthen, 1968.

[63] The terms **'vision-for-perception'** (responsible for recognising and describing what a person is seeing), and **'vision-for-action'** (responsible for perceptually guided movements) (Brown, Halpert & Goodale, 2005) aptly summarise the meaningful functionality and complementarity of both visual systems.

translates it into the appropriate motor control code in order to produce the required body movement. Full attention to the demonstration rather than mere observation, alongside the retention process (in which the observation material is transformed and restructured into symbolic codes that are stored in the memory), is essential for behaviour reproduction. For the latter, the dynamic view of modelling (Scully & Newell, 1985) proposes that the visual system is capable of automatically processing visual information and to trigger the motor control system to act in accordance with what the vision detects. Here, the visual system 'picks up' salient information from the model that effectively instigate the body and limbs to act in specific ways, and it does so without a need to transform the information received via the visual system into a cognitive code and store it in memory. In other words, this theory assumes that visual information directly provides the basis for coordination and control of the various body parts required to produce the action.

Thus it can be said that the main difference between *cognitive mediation theory* (Bandura, 1986) and the *dynamic view of modelling* (Gibson, 1966, 1977; Scully & Newell, 1985) is whether the translation from perception to action is direct or mediated by mental representations. Insights given with the discovery of 'mirror neurons' in the early 1990s (Di Pellegrino, Fadiga, Fogassi, Gallese & Rizzolatti, 1992; Gallese, Fadiga, Fogassi & Rizzolatti, 1996) remain somehow in-between these two theories. More specifically, whilst arguments based on the mirror neuron system (MNS), suggest that mere observation of movement stimulates the brain, it posits nevertheless that the brain activates patterns and schema identical to those in place when producing the movement itself (see Rizzolatti, Fogassi & Gallese, 2001). Such proposed existence of a 'schema', or in other words 'internal representation' strongly resonates with concepts of cognitive mediation theory. However, MNS theory has also been criticised in recent years (see Catmur, Walsh & Heyes, 2009; Heyes, 2010; Hickok, 2009), particularly the suggestion that mirror neurons are adapted trough evolutionary processes for encoding action goals. Such criticism was mostly raised by authors in favour of the *associative hypothesis* (Heyes, 2010). The associative hypothesis claims that the mirror neuron system is developed through sensory-motor association learning (Heyes, 2010), in which repeated experiences enable the association of sensory events with specific motor actions. Through this process, excitatory links are generated that contribute for the development of 'internal models'. Evidence favouring the associative hypothesis has interestingly arisen from music and dance contexts. FMRI studies using similar methodologies have shown that expert pianists (Haslinger, Erhard, Altenmuller, Schroeder, Boecker & Ceballos-Baumann, 2005) and expert dancers (Calvo-Merino, Glaser, Grèzes, Passingham & Haggard, 2005) exhibited stronger activations in MNS brain areas when observing familiar movement, related to their areas of expertise. More precisely, the pianists showed MNS stronger brain activations when observing piano-playing finger movements, in opposition to non-piano-playing finger movements and in comparison to a control group of non-piano players. And expert dancers showed similar results when observing a familiar dance style, in contrast to a dance naive control group.

Considering all of this in relation to the aims of this chapter, a crucial question arises: *what do observers perceive from observation*? In terms of motor skill learning, there is substantial evidence that observers not only perceive information about the coordination patterns of the to-be-learned-skill through demonstration (Horn & Williams, 2004; Scully & Newell, 1985). Instead, and more importantly, observers use invariant features of the coordinated movement pattern to develop their own movement pattern to perform the skill – that is: people rarely use specific characteristics of the individual components of a particular action when judging an observed action pattern, and instead use relative information about the relationships among the various components (Cutting & Kozlowski, 1977; Johansson, 1973). Put more simply: what people perceive is *not* any characteristic of the moving limbs, such as velocity; rather, people use the invariant relative time relationship between two components of the moving limbs (Schoenfelder-Zohdi, 1992). As such, the invariant relationships in coordinated movement constitute critical information involved in observational learning. As well as all of this, observation was found to produce greater learner outcomes in opposition to the use of only verbal directives: participants who observed a skilled model performing the skill were able to develop coordinated movement patterns earlier than those who received only verbal information about the task (Schoenfelder-Zohdi, 1992). This was regardless of (and with no differences from) the fact that observation could be done through watched video or point-light displays of a soccer-chipping skill (Horn, Scott, Williams & Hodges, 2005). Another crucial aspect to take into account in relation to observational learning is that the effectiveness of observed demonstrations greatly depends upon the characteristics of the skill to be learned, and to be beneficial, the to-be learned skill should require the acquisition of a new pattern of coordination (Magill & Schoenfelder-Zohdi, 1996). To this, the characteristics of the skill to be learned in addition to the relation and interaction between vision and other sources of perception needs to carefully considered. For instance, it has been claimed that visual demonstrations are less effective for learning rhythmical skills, and suggested that in such cases auditory forms of demonstration seems to work best. This was shown on an experiment in which people that had no prior dance or music experience learned a sequence of 32 choreographed steps for acquiring the rhythmic timing of the sequence. People who heard only the timing structure learned it as well as those who both saw and heard the sequence performed by a model (Wuyts & Bueckers, 1995). In another experiment, auditory modelling was shown to enhance the learning of a sequence of five time-intervals when two keyboard keys were depressed alternatively. In this study, participants heard a sequence of tones that represented the timing sequence they were to learn, before each trial (Lay, Sparrow, Hughes & O'Dwyer, 2002).

As discussed throughout this sub-section, observation is helpful for learning and frequent observations appear to provide better learning outcomes leading to conclude that learners will benefit from demonstrations before and during practice as frequently as necessary (Carroll & Bandura, 1990; Weeks & Anderson, 2000). Learners will also benefit from accurate demonstrations in which they can grasp the invariant movement patterns and strategies used in problem solving. This leads to the importance of devising appropriate demonstration principles that can help providing teachers, tutors, coaches and relevant others with the empirical knowledge needed for promoting students' learning effectiveness. However, attention needs to be given to deciding what type of demonstration is adequate for the intended learning outcomes.

6.1.2 Learning through imitation

The main focus of this sub-section is on relevant knowledge related to the cognitive and neurological mechanisms involved in the process of imitation learning. Research into imitation has been primarily concerned with: establishing the cognitive and neurological mechanisms that enable an observed body movement to be converted into enacted body movement (usually referred to as the correspondence problem) (e.g. Catmur et al., 2009; Heyes & Ray, 2000; Massen & Prinz, 2009; Prinz, 2002); the role of imitation in day-to-day social interaction (e.g. Chartrand & Bargh, 1999; Leighton, Bird, Orsini & Heyes, 2010; van Baaren, Janssen, Chartrand & Dijksterhuis, 2009); and the role of imitation in relation to evolutionary theories and cultural inheritance (e.g. Shea, 2009; Tennie, Call & Tomasello, 2009; Whiten, McGuigan, Marshall-Pescini & Hopper, 2009; Williams et al., 2001). Learning through imitation demands a complex set of mechanisms that map an observed movement of a teacher, instructor or other person, onto one's own movement repertoire through a process of alternating phases of observation and of motor execution (see Higuchi, Holle, Roberts, Eickhoff & Vogt, 2012; Schaal, Ijspeert & Billard, 2003; Vogt et al., 2007). However, 'imitational learning' needs to be distinguished from the term 'observational practice' (Vogt, 1995) which entails learning by observing in the absence of motor execution (see Mattar & Gribble, 2005).

As evident in the process of imitation learning, observation and imitation are interconnected processes working in conjunction towards achieving the action goal. For instance, eyes and body work together in a coordinated way to enable the act of playing piano; that is, the visual perception of a particular demonstration and the actual limb movement required to achieve the action of playing piano using a certain intended movement are 'coupled'. In other words, visual perception and limb movement are coordinated in a way that enables people to perform eye-hand and/or eye-foot coordination skills. The spatial and temporal coordination of vision and hands (and in the case of piano playing other essential pianist anatomical structures such as arms, elbows, wrists and fingers) is known as 'perception-action coupling'. The study of eye-hand coordination skills involves identifying the point of gaze (specific location in the environment on which central vision is fixated at a particular moment) and calculating the relationship between the timing and/or location of the termination of the point of gaze with the timing and/or location of the hand movement (see Magill, 2007). Evidence for temporal coupling between the eye and hand movements is given by findings revealing that the completion of the initial eye movement coincided with the timing of the peak acceleration and velocity of the hand movement (Helsen, Elliott, Starkes & Ricker, 1998)[64]. But there is more to this (as pointed out by the above researchers): the initiation of elbow and shoulder movements is also coupled in time with eye and finger movement initiation. The sequence of events is that the eyes move first, followed by the shoulder, then the elbow, and finally the finger (for a review see Elliott, Helsen & Chua, 2001). These results support the importance of vision for picking up critical spatial information to initiate and guide hand movement to a target and to provide spatial and temporal feedback to ensure the accurate arrival of the hand at the target. The process of imitation is such that while the movement is in progress, people are still able to undergo movement corrections whenever there is enough time to detect and modify the movement. Although the minimum amount of time needed is still a subject of discussion, it is suggested that an estimate range from 100 to 160 msec is a reasonable amount of time to undergo movement correction for most motor skills, and would become even faster when the person is able to anticipate the need to make a movement correction (e.g. Brenner & Smeets, 1997; Smith & Bowen, 1980).

In fact, even during pure observational practice, learners engage neurocognitive systems for motor planning and control (for a review see Vogt & Thomaschke, 2007). Action observation evokes stimulation of not only in higher order visual are-

[64] In this study, participants were requested to move their index finger 40 cm from a given location, to the right and as fast as possible.

as, but also in areas traditionally known to be devoted to motor functions. Such findings do not, however, answer the question of how the mind/brain converts an observed demonstration into an enacted body movement per se. The commonly accepted interpretation is that the observed action is directly matched with the observer's own motor prototype of this action (Rizzolatti, Fogassi & Gallese, 2001). In this perception-action matching, two regions have been identified in the human brain subserving this mechanism: the caudal part of the inferior frontal gyrus including the adjacent ventral premotor cortex and the rostra part of the inferior parietal lobule. This circuit directly involved in perception-action matching has become known as the "mirror neuron system" (MNS) and is likely to subserve more than a single cognitive function (Rizzolatti & Craighero, 2004; Wilson & Knoblich, 2005). Although there have been some suggestions that the MNS is also involved in movement imitation (Iacoboni et al., 1999; Iacoboni, 2005), such claims are not widely accepted given the fact that the above studies used simple and overlearned actions (i.e. actions that were not representative of typical situations faced by learners when acquiring a new and complex action that is not yet in their behavioural repertoire).

Nevertheless, recent studies have shown that action perception and action production are intimately related, to the extent that even when we do not wish to imitate, perceiving an action activates the same neural (MNS) and representational structures (shared representations) involved in action production (Catmur et al., 2009; Massen & Prinz, 2009). This draws the conclusion that the perception and execution of an action depends upon the use of the same neurophysiological structures. Moreover, the impulse to imitate happens not only when people want to imitate, but also whenever they actually watch another person's behaviour. It is suggested that rather than being innate, physiological structures such as the MNS and representational structures develop through exposure and experience of observing and executing actions (Catmur, 2009; Heyes, 2010). This resonates well with suggestions rising from the *associative sequence learning theory* that the correspondence question (how does the mind/brain convert an observed demonstration into an enacted body movement?) can be explored more effectively through a better understanding of sensorimotor learning processes (Heyes, 2010). In fact, increasing evidence suggests that imitation learning engages additional, general purpose mechanisms of learning and cognitive control that evolved for sensory and motor sequence processing, rather than for imitation specifically (Catmur et al., 2009; Heyes & Ray, 2000; Massen & Prinz, 2009). These insights suggest that associative learning mechanisms, based on socio-cultural input, build mirror neurons and other shared representations. As such, it is not surprising that emphasis has been placed onto the importance of active teaching and social norms in order to ensure faithful copying (Tennie, Call & Tomasello, 2009).

The fact that perceiving an action activates the same neural (MNS) and representational structures (shared representations) involved in action production (Catmur, 2009; Massen & Prinz, 2009) can also help us to question the level of control an individual may (or may not) have over his/her own imitations. In other words, how can it be ensured that imitative behaviour is goal-directed rather than compulsive (Brass, Ruby & Spengler, 2009)? At this level, the tempero-parietal junction appears to have a relevant role in helping people distinguish between their own acts and the acts of others, whereas the anterior fronto-median cortex enables own intentions to be enforced – when confronted with an evoked imitative response. In fact, Rumiati, Carmo and Corradi-Dell'Acqua (2009) propose that human imitation is a strategic process from the point of view that executive processes determine whether observed actions are processed via large scale, semantic representations of actions, or as a series of meaningless action fragments. However, it should not be assumed from this that imitation is (or needs to be) an always intentional process in order to play an important role in cognitive and social development. Indeed unintentional imitation has been shown to be as powerful as intentional imitation in relation to cooperative behaviour (van Baaren, Janssen, Chartrand & Dijksterhuis, 2009). This is evident in the phenomena known as 'chameleon effect' in adults and 'over-copying' in children which suggest that even when people have limited control over imitative behaviour (such as unintentionality copying others people's gestures[65]), imitation can have far-reaching positive outcomes (Whiten, McGuigan, Marshall-Pescini & Hopper, 2009). This type of imitation is referred to in some sources as 'non-conscious mimicry' (van Baaren et al., 2009) or automatic imitation (Leighton, Bird, Orsini & Heyes, 2010).

Recent neuroimaging studies have confirmed that action observation and imitative action involve a bilateral network situated in the ventral premotor and inferior parietal cortex (Caspers, Zilles, Laird & Eickhoff, 2010). Such bilateral network has been debated regarding possible roles in action recognition and conceptual processing (Gallese, Gernsbacher, Heyes, Hickok & Iacoboni, 2011; Hickok & Hauser, 2010; Kilner & Lemon, 2013). Relevant findings are that action observation on its own does not foster the formation of lower-level motor associative processes to the same extent as physical practice (Higuchi et al., 2012). Thus, it can be concluded from the above that teacher demonstrations at the start of the learning process may accelerate the learning process given that imitation significantly reduces that amount

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[65] **'Chameleon effect'** is a term given to the observed phenomena that adults in conversation sometimes tend to copy each other's gestures and mannerisms, in order to smooth the communicational interaction. For more consult Chartrand & Bargh, 1999. **'Over-copying'** refers to a similar process as described just above, but in relation to children, who tend to repeatedly imitate adults gestures.

of trial-and-error needed to fulfil the movement goal, whenever an accurate representation (in the form of demonstration) is given. However, understanding the detailed principles that subserve imitation, departing from the visual perception of teacher to issuing the motor commands that move the limbs of the student is key for optimising the processes of teaching and learning of motor skills acquisition.

6.1.3 Relationship between auditory and motor learning processes

The fundamental goal of playing a musical instrument is to produce sound, and in all musical traditions sound is composed of two sequential structures: "the ordering of pitches and the temporal intervals between successive pitches" (Brown et al., 2013; Palmer, 1997). In terms of sound perception, it is unclear if pitch and temporal structures are perceived separately or as one integrated process. However, a study comparing the brains of fourteen pianists through FMRI scanning, while they listened to and performed melodies on a piano keyboard revealed that sensorimotor mapping networks are sensitive to both pitch and temporal structure leading to suggestions that pitch and temporal structure are largely integrated in auditory–motor transformations (Brown et al., 2013). Auditory-motor integration engages a network of neural regions, including the auditory and premotor cortex and parietal regions (e.g. Bangert et al., 2006; Baumann, Koeneke, Schmidt, Meyer, Lutz & Jäncke, 2007; Hickok & Poeppel, 2004). Indeed, playing a musical instrument requires knowledge regarding the relationship between the motor actions required to deal with the musical instrument and the auditory consequences of such actions (Maes et al., 2014). Such knowledge is acquired gradually, through the arbitrary actions involved in instrument manipulation versus the (at least initially) unexpected auditory events (Hommel, 2003). In addition, in this explorative process of interaction, systematic repetitions also lead to a process of association between the heard sounds and motor actions which originated those sounds, culminating in the development of internal models (Maes et al., 2014). For such reason, Maes et al. (2014: 4) not only argue that learning to play a musical instrument is a "highly illustrative case of sensory-motor association learning" (see Heyes, 2010) "in which actions and perception become intrinsically interwoven", but also that the integration of internal models of sensory-motor relationships may in itself exert influence on perception processes. As a consequence of this, the integration can "shape the musical mind" (Maes et al., 2014: 4). These authors support their claims through evidence suggesting that people engaged in instrumental music tuition develop auditory-motor links as a result of training (Bangert & Altenmüller, 2003; D'Ausilio, Altenmüller, Olivetti, Belardinelli & Lotze, 2006; Herholz & Zatorre, 2012). This is particularly the case for people who were submitted to intensive training and long term process of skill acquisition (Brown & Palmer, 2013). Furthermore, Maes et al., (2014) discuss empirical evidence suggesting the effects of both: a) motor association learning in the case of music instrumental training on auditory perception; and b) the effects of auditory perception on motor responses. Such dynamic interaction between 'perception and action' and 'action perception' is explained (respectively) through inverse and forward models (discussed in more detail in Section 5.1.4).

Through Inverse models, researchers have tried to understand how the auditory perception of music induces body movements in listeners. Explanations for how this process occurs have been given, for example, by Laban and Ullmann (1966) who suggest an association between physical human movement and expressive qualities such as flow, space, time, weight. More recently, Leman (2010) argues that the body works as a mediator between sensory-motor process and mental states (Leman's argument is discussed in more detail in Section 5.1.1). Thus simply listening to music provokes motor responses, and these responses are a result of previously internalised associations between perceived sounds and their respective motor resonance/s (Bangert & Altenmüller, 2003; Baumann et al., 2007; Hurley, 2008; Schütz-Bosbach & Prinz, 2007). Moreover, a certain action is automatically activated in the event of auditory perception – leading to acoustic properties of the music to be translated both into body movements (see Caramiaux, Bevilacqua & Schnell, 2010; Kussner, 2013; Leman & Godoy, 2010) and emotions. This emotional component is elsewhere reported in terms of how people listening to music can 'feel' 'immersed' in the musical experience, to the extent that body movements prompted by music can cause a sense of 'human agency' and 'imagined participation' in the production of sound. Such phenomena is documented by several researchers and referred to with different terminological labels such as 'kinaesthetic empathy' (Mead, 1999), 'simulated control' (Leman, 2007), 'imagined activity' (Maus, 1988), and 'experience of flow' (Csikszentmihalyi, 1990).

Regarding forward models (that analyse the flow of information from action to perception, and thus focus on predicting likely sensory outcomes of a certain action) there is evidence that auditory perception is modulated by a motor-based prediction mechanism (see Bäss, Jacobsen & Schröger, 2008; Loehr, 2013; Schubotz, 2007). This is to say that "planning or executing an action causes a copy of the motor command to be made ... which enables a prediction of the auditory outcome of that motor command" (Maes et al., 2014: 6). This effect occurs because auditory stimuli such as language and music are sequential. In other words, tones and words follow one another in certain specific orders, and this enables people to predict upcoming sounds by basing their experience upon their own previous perceptions

(Jones, 1987; Tillmann, 2012). Here the perception of auditory sequences that have been previously produced induces sensorimotor prediction mechanisms, resulting in a model of the motor plan associated with an upcoming auditory event being generated (Schubotz, 2007). This predictive element has been shown to attenuate the perception of the experienced sensory outcome (Aliu, Houde & Nagarajan, 2009; Heinks-Maldonado, Nagarajan & Houde, 2006). More specifically, in a study dedicated to evaluating the role of attention on the ability to predict motor actions as a result of auditory stimuli (Timm et al., 2013), participants were required to place their attention on either the sound, the motor movement action, or visual information. The findings revealed that attenuation effects were independent from allocation of attention. Elsewhere, contradictory results have been found by research into the relationships existing between attenuation of auditory stimuli in conditions of observing sound producing actions versus self-generating sound. Whilst Sato (2008), for instance, revealed similar attenuation effects for both observing and self-generating sound, Weiss and Schütz-Bosbach (2012) findings suggest a high auditory attenuation effect for self-generated sound producing actions – in opposition to the simple observation of the sound producing action being performed. In light of such inconsistent findings, instrumental music teachers have little to no convincing guidance as to the effects of observation versus self-generation of sound – making it difficult (if not impossible) to apply one theory or another to their pedagogical practices.

The aforementioned prediction mechanisms could not occur without the combining effects that occur between motor and auditory learning. In practical terms, this is in relation to auditory memory evidenced by instrumental music players' strong associations between their movements and specific auditory outcomes over time (Palmer, 1997; Zatorre, Chen & Penhune, 2007). Research has shown that sounds *produced* with one's own motor system are better recognised than sounds that have simply been *perceived* (in which physical sound production did not occur) (MacLeod, Gopie, Hourihan, Neary & Ozubko, 2010). This also applies to spoken words, which are usually more easily remembered when verbally articulated with sound production in comparison to words that are either mouthed without sound (Gathercole & Conway, 1988), or listened to without movement (MacDonald & MacLeod, 1998). Similarly, musical melodies performed by pianists on a keyboard with normal auditory feedback were shown to be better recognised than melodies which were only perceived, or that were produced without sound (Brown & Palmer, 2012). This was shown in Brown and Palmer's study (2012) in which they submitted pianists to four learning conditions: auditory only; motor only; normal performance (for a desired strongly coupled auditory-motor learning condition); and performing along with sound-only-recordings without hearing the auditory feedback of their own playing (for a weekly coupled auditory-motor learning condition). The results suggested that pianist participants exposed to motor learning (associated with a 'normal' music performance condition) had higher levels of melody auditory recognition in the required melody recognition test, well beyond auditory learning alone. Such finding lead these authors to conclude that sensory-motor associations formed during the learning process provide retrieval cues, and can potentially shape auditory perception through mental simulation of action. This is in accordance with previous findings (Hazeltine, Aparicio, Weinstein & Ivry, 2007), which state that the learning of configural actions – such as playing chords on the guitar or piano – are learned, and are not a result of a generalised capacity or audio-visuo-motor matching. Although the exact mechanisms of production-based memory recognition are still unknown, there seems to be a strong link between improved memory recognition and sensorimotor processing of auditory stimuli. This is not only the case for learning to speak a new language, but also for playing a musical instrument where sensorimotor experience appears to yield significant brain changes: not only structurally (Hyde et al., 2009; Schlaugh et al., 2009) but also functionally (Jäncke, 2012; Ungerleider, Doyon & Karni, 2002). Such findings are relevant for the instrumental music teaching context, where musicians' general belief that "the mystery of their art cannot be objectively studied, quantified or explained" (Mornell, 2009: 265) is arguably to blame for the present paucity of research into the role of movement/gesture in instrumental music teaching and learning. And if learning to play a musical instrument occurs through sensory-motor association processes (see Heyes, 2010) "in which actions and perception become intrinsically interwoven" (Maes et al., 2014: 4) then, by extension, it becomes increasingly relevant to understand the influence of specific teaching strategies for student learning outcomes. Such understanding holds the potential for the establishment of specific teaching strategies that are best suited for aiding learning, and that can contribute to a much needed empirically based teaching practice in this context.

6.2 Study - Seeing how it sounds: observation, imitation and learning in piano playing

Although there are a variety of research avenues that could be taken when attempting to relate teachers' gestural demonstrations and student learning effectiveness in the instrumental music pedagogical scenario, the focus of present investigation is on providing answers to the following questions, through an experiment:

1. What are the effects of student observation followed by students' imitation of piano teacher Mimic gestures for students' staccato performance over time, in terms of knowledge retention and transfer?

2. What is the effect of students' alternation of observation and imitation of piano teacher Mimic gestures, for students' staccato performance over time, in terms of students' knowledge retention and transfer?

The nature of the above research question implies that they are better answered through an experiment since the intended study involves studying effects of a teaching strategy, making it important to place students in different learning conditions in order to enable a comparison of results between groups and a control group. In addition, participants within-groups, need to be placed in similar and controlled learning conditions in order to exclude confound variables that could lead to alternative results (see Jackson, 2008). The study was undertaken on a piano learning environment in which students of differing proficiency levels (N=48), learning to perform a specific type of staccato (a full description is given in the Method section) were submitted to three different (group exclusive) teaching conditions. These were: audio-only: audio representation of a staccato task; blocked-observation: observation of teacher's Mimic gestures followed by students' performance of the task – i.e. imitation of a set amount of teacher Mimic gestures; and interleaved-observation: observation of teacher's Mimic gestures while alternating the performance of the task (student imitation of teacher Mimic gesture) with teacher's performance. Two different proficiency levels of students were tested: levels between pre-grade 1 and grade 3 (group I) and students with piano proficiency between grades 4 to 8 (group II). Learning was measured in relation to students' range of wrist amplitude (RWA) and ratio of sound and inter-sound duration (SIDR) using retention[66] and transfer tests[67] performed at different points in time. RWA evaluates students' level of use of the Mimic gesture performed by the teacher during the demonstration and SIDR evaluates staccato performance in terms of its own very definition: "a particular type of sound articulation in which successive tones are separated by a silence gap and also short in duration" (Repp, 1998). The SIDR measurement undertaken is in agreement with Bresin (2001), although the author terms this measurement as 'articulation index'. Given that in music there many different types of sound articulation, I decided to term this measure as SIDR instead in order to account for higher terminology specificity.

In addition it is relevant to state that the term Mimic in the course of this study is used to refer to the gesture used by the teacher in the course of a gestural demonstration intended at showing students how to perform a particular musical sound producing action while expecting the student to imitate the gesture shown (Simones et al., 2013); and imitation refers to students' intentional copying of teacher's bodily movement, that in this case consists of a Mimic gesture. The researcher acted as teacher in this experiment, interacting with students under the conditions outlined in the Method section. Video teaching conditions were *not* considered appropriate for researching gesture in this context for two reasons: formal learning of a musical instrument in the western world mostly follows a one-to-one teach-

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[66] Learning evaluation is typically done by evaluating students' knowledge retention and transfer in the fields of education, psychology and other relevant fields, be it in terms of evaluating learning of conceptual knowledge (more abstract nature) or motor learning in general (e.g. Magill, 2007) (although not exclusively). **Retention**, evaluates the "persistence characteristic of improved performance" (Magill, 2007: 253), through retention tests designed to infer how much knowledge students were able to retain in sequence of a certain educational experience.

[67] **Transfer** is "a means of inferring learning through the adaptability aspect of performance changes in relation to learning" (Magill, 2007: 253). Transfer tests involve a new situation, different than the one used in the learning experience, either a different context for performing the learned content/skill or a variation of the skill itself.

ing/learning setting in which interaction between teacher and student is of a highly practical nature and for which imitation is an important component in the learning process; and elsewhere it has been shown that people tend to synchronize more accurately with a human partner than with a recording (Himberg, 2006). As demonstrated by the results, different gestural conditions yielded different levels of learning effectiveness implying a need for the empirical establishment of gestural performance demonstrations across specific contexts and this is fully discussed throughout the discussion and conclusion subsections.

6.2.1 Method

Participants

Informed written consent for research participation was obtained for 52 piano students in Belfast, Northern Ireland (see appendix G for ethics application and appendix H for participants' information and consent forms for this study). After an initial screening test 48 participants were accepted for the experiment and were divided into two groups, according to their piano proficiency levels (in accordance to the requirements of the Associated Board of the Royal Schools of Music), as follows:

- Group I: students with piano proficiency levels between pre-grade 1 and grade 3 (a total of 17 females and 8 males, ages ranging from 5 to 14 years old).
- Group II: students with piano proficiency between grades 4 to 8 (a total 15 females and 8 males, ages ranging from 13 to 44 years old).

Table 6.1 (next page) describes the allocation of participants per teaching condition, their age ranges and average time they have been engaged in formal piano teaching and learning, at the time of the experiment.

Table 6.1. Participants' characteristics: gender, age range and average time of engagement in formal piano tuition per experimental condition.

Teaching condition	Group I Gender		Group I Age range	Group I Average experience*	Group II Gender		Group II Age range	Group II Average Experi-ence*
	Female	Male			Female	Male		
Audio-only	4	4	5 to 14	1 year	3	4	13 to 44	11 years
Blocked-observation	5	3	8 to 14	1 year	7	2	12 to 23	7 years
Interleaved-observation	8	1	6 to 9	1 year	5	2	11 to 22	6 years
Total	17	8		1 year	15	8		8 years

Note. * Average time participants were engaged in formal piano teaching and learning

Materials

Both the experiment and associated tests were carried out using the same room and a Yamaha C3 grand piano. Video data were recorded using a Sony, high-definition camera (positioned laterally to the piano, facing the keyboard and piano chair, at a height of 1.04 metres and distance of 1.72 metres, capturing images of the researcher and student). Audio recordings of trials were taken using a portable stereo audio recorder (Tascam HD-P2, connected to a microphone at a height of 130 cm and a distance of 57 cm to the piano resonance box). The digital videos were converted to Windows Media files, analysed using Kinovea software (downloaded from http://www.kinovea.org/), and the audio data was analysed using Matlab software (Release 2013a, The MathWorks, Inc., Natick, Massachusetts, United States). The audio recording of the staccato task for the audio-only teaching condition was prepared using the above physical, acoustical and recording settings, and was played through the built-in speakers of a Dell Inspiron computer.

Design

The experiment followed a between-groups design[68] (3 learning conditions X 2 proficiency levels). As such, participants only took part in one group and were submitted to one experimental condition. The independent variables were teacher Mimics gesture applied for teaching students to play staccato and student proficiency level. The type of staccato used for the experiment involved two sequenced continuous movements: wrist extension prior to hitting the piano key and wrist flexion while hitting the piano key, and afterwards (extension and flexion movements as used for the purposes of this study are described in Figure 6.1, below).

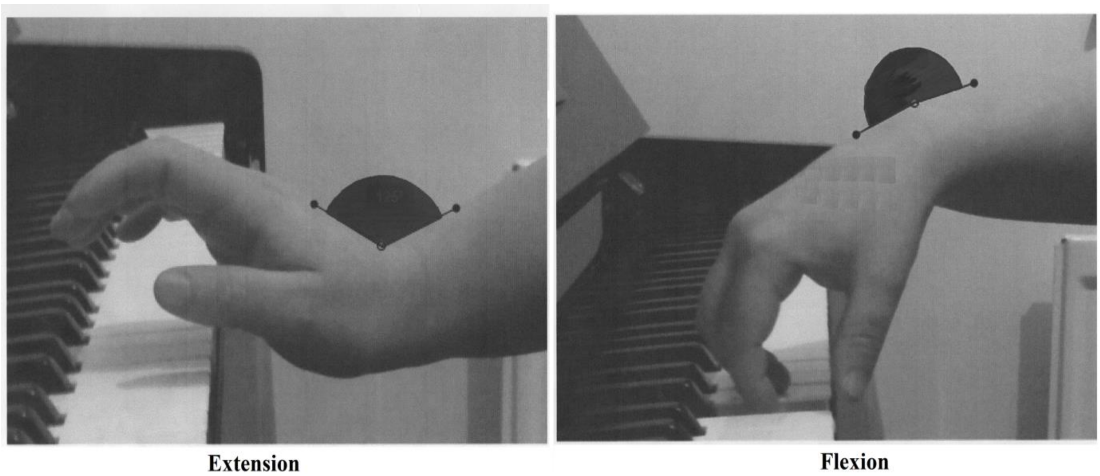

Figure 6.1. Description of the extension and flexion movements used to perform the Mimic gesture performed for this study.

Students' staccato learning was evaluated by the following two dependent variables: Range of Wrist Angle (RWA) (in accordance to the Mimic gesture employed during the experiment), calculated as the difference between students' wrist flexion and extension in degrees (see Figure 6.1); and Sound versus Inter-onset Duration Ratio (SIDR) (in relation to the staccato sound definition). Reliability for RWA

[68] The term **'between-groups'** refers to experiments in which two or more groups of participants are each submitted to a different testing condition.

was established by Pearson r correlation coefficient computed to assess the relationship between wrist flexion and extension values obtained by the researcher and those retrieved by an independent annotator, on same video frames using 5% of the totality of frames in the analysis (154 from a total of 3070 frames). There was a positive correlation between the values retrieved by the researcher and the annotator: $r = 0.98$, $n = 154$, $p = .0005$.

SIDR was calculated by dividing note duration by their respective inter-onset interval (in accordance with Bresin, 2001). The inter-onset interval is the duration between the onset of the note, and the onset of the next note. The threshold value for slowest note decaying frequency was set at -30db, as suggested by Mason & Harrington (2007). Better staccato performance would be indicated by shorter note duration (low SIDR) and larger wrist rotation (higher RWA). For each trial, the means of both measures were calculated to provide values for subsequent analysis. RWA and SIDR were evaluated by retention and transfer tests, as described in the following section.

Procedure

The experiment was carried out by the primary researcher, an experienced piano teacher, with a piano teaching experience of 22 years, and all sessions of the experiment and associated tests were video recorded. The researcher prepared, memorised and rehearsed a monologue with equal verbal information and specified use of gesture for all three groups in the experiment (appendix G). Since communication in the classroom would seem unnatural if only Mimics gestures were used, the researcher elected to employ deictic (pointing) gestures on a limited and specified number of occasions (see Table 6.2, page 219). It was assumed that this gesture would help to instruct and direct participants in the required task without influencing their performances. Special care was taken in the script preparation to ensure that eye gaze, voice intonation and gestural performance were as uniform as possible across conditions. To ensure validity in this regard, all video recordings of experiment delivery were viewed by the researcher and two independent annotators who evaluated researcher delivery performance in relation to the planned experiment components as in the planned script: use of words, gesture, eye gaze and voice intonation. Inter annotator reliability was assessed (in accordance with Bakeman & Gottman's 1986 requisites for observational techniques), and based on the following question posed for each the above variables: did researcher use words, gesture, eye gaze and voice intonation in accordance to the planned scrip? It was preconised that answers should simply be *yes* or *no*. Cohen's (1960) Kappa agreement levels for *yes* answers were as follows: use of words at least .72; gesture and eye gaze equal to 1; and voice intonation at least .78. All with $p < .0005$ and based on the observation of 48 videos.

Four participants were excluded after submitted to a pre-test designed to evaluate their previous knowledge of staccato performance given that they employed the two sequenced and continuous movements in use for the Mimics gesture in this study. Such exclusion is justified on the grounds that it would be impossible to associate these participants' results to the teaching conditions being tested in this study. Prior to the experiment students were asked to follow the instructions given by the researcher without asking questions or talking, in order to keep similar conditions across groups. The teaching conditions to which students were submitted and the task they were required to perform during the experiment are described in Table 6.2 (next page).

Table 6.2. Description of teaching and learning conditions used in the experiment

	Instruction given to participants		**Demonstration given to participants**		**Participant's task**
Condition	**Verbal**	**Gestural**	**Activity**	**Gestural**	
Audio-only	Explanation of how to perform an ascending staccato scale starting on middle C, focusing on staccato definition in terms of sound quality	Two Deictic gestures	Audio recording of a staccato scale, starting on middle C listened five consecutive times	None	To play a staccato scale, starting on middle C, five times, using only second finger of the right hand, after listening to the audio recording.
Blocked-observation	Explanation of how to perform an ascending staccato scale starting on middle C, focusing on staccato definition in terms of sound quality	Two Deictic gestures	Researcher performs a staccato scale, starting on middle C, five ***consecutive*** times	Mimic* for each note	To ***observe*** the demonstration and ***play*** the same staccato scale ***afterwards***, using only the second finger of the right hand, five times.
Interleaved-observation	Explanations of how to perform an ascending staccato scale starting on middle C, focusing on staccato definition in terms of sound quality	Two Deictic gestures	Researcher performs a staccato scale, starting on middle C, ***alternating*** each of the five staccato scales, with student's performance.	Mimic* for each note	To ***observe*** and ***play*** the staccato scale while ***intercalating*** each scale with researcher's demonstrations, using only the second finger of right hand, five times.

Note. * A total of eight Mimic gestures were performed for each staccato scale. A description of this gesture as performed for the experiment can be seen in Figure 6.1

After the experiment retention and transfer tests were carried out with all participants (in accordance with Schmidt & Lee, 2005), with same instructions given regardless of the type of experimental condition participants were submitted to. Retention tests (carried out at three different points in time) consisted of student's performance of the material taught during the experiment (see Table 6.3, next page). The transfer test was carried out only immediately after the first retention test and consisted of a similar but newer task.

Table 6.3. Retention and transfer tests timetable and task required per test

	Retention	Transfer
Immediately after the experiment	Ascending staccato scale starting and finishing on middle C	Ascending staccato scale starting and finishing on middle G, using only piano white keys
Twenty four hours after the experiment	Same as above	
Eight days after the experiment	Same as above	

Statistical Analysis

Given that SIDR and RWA were measured using continuous scales (comprising of mean values of repeated measurements) at three different points in time, multilevel linear regression (two level models) with repeat measurements nested with subjects was considered the most suitable approach for analysis: SIDR values were found to be normally distributed and the RWA values had a positively skewed distribution when initially viewed. However, after fitting the regression models, the residuals were approximately normally distributed, and thus the assumptions for parametric analysis were met**.**

Two sets of analyses were carried out in which three predictor variables were considered: Students Proficiency Levels (group I and group II), Teaching Conditions (audio-only, blocked-observation and interleaved-observation), and the point in time at which the retention tests were carried out (Retention 1, 2 and 3). Interactions that were *not* statistically significant were omitted from the model to ease interpretation of the results. The first set of analyses just examined the retention tests data, and the second set examined retention in comparison to the transfer test, both at the first point in time only. The figures reported are the regression coefficients, along with corresponding confidence intervals. These give the mean difference between categories and a baseline category. *P*-values indicate the overall significance of each factor. Additional post-hoc comparisons were made between pairs of categories, for those variables where there were more than two categories. In addition, to allow for multiple testing between groups (and thus an increased risk of finding a significant result due to chance alone), the *p*-values from the post-hoc comparisons were given a Bonferroni adjustment.

6.2.2 Results

Retention

Sound. There was a significant difference in SIDR of students submitted to different teaching conditions ($p<0.001$): students in the blocked-observation condition (b=-0.09, 95% CI -0.14 to -0.03) and in interleaved-observation condition (b=-0.12, 95% CI -0.18 to -0.06) had significantly lower SIDR values than those submitted to the audio-only condition. As such, students who observed Mimic gesture demonstrations performed shorter notes than those who simply heard the target scales, with students in the interleaved-observation condition performing shorter notes than students submitted to the other two teaching conditions. Thus students who observed the Mimic gesture between each scale attempt were more proficient at staccato playing in accordance to the staccato definition in each of the retention tests, than students in the other learning conditions. However, there was a statistically significant tendency for SIDR values to increase over time: at retention test 2 (performed 24 hours after 1) the values were slightly increased in comparison to time 1 for all teaching conditions, except for the audio-only group, which presented slightly decreased SIDR values in retention test 2, that actually significantly increased by retention test 3. The average SIDR value at retention test 3 (performed eight days after retention test 1) was 0.06 higher than at retention test 1 (b=0.06, 95% CI -0.03 to 0.09) (see Figure 6.2, below). There was no significant difference in SIDR between student proficiency level groups (b=0.02, 95% CI -0.03 to 0.07, *p*=0.45).

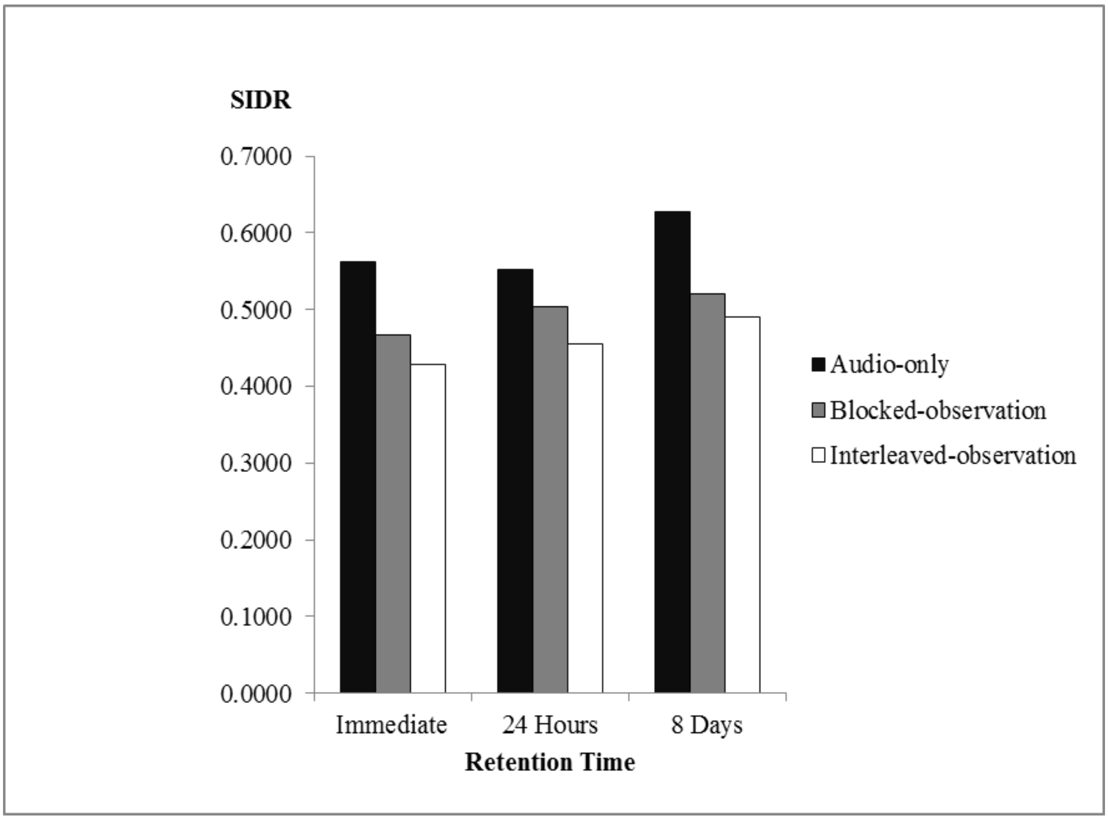

Figure 6.2. SIDR (Sound versus Inter-Onset Duration Ratio) mean values overtime, per teaching condition, for all students (proficiency groups I and II combined). Lower values indicate more staccato playing, which was the goal of the task.

Movement. There was a significant difference in RWA of students submitted to different teaching conditions ($p<0.001$): students submitted to interleaved-observation (b=25.6, 95% CI 19.7 to 31.6) rotated their wrist more; on average 26 degrees more in comparison to students submitted to audio-only condition (which showed the lowest RWA values). In relation to blocked-observation (b=9.3, 95% CI 3.6 to 15.1), students submitted to interleaved-observation presented RWA values 17 degrees higher on average. As shown by these values, students submitted to interleaved-observation were more proficient at performing the Mimic gesture used for this experiment. The results suggested no difference in RWA between student proficiency groups (b=-2.9, 95% CI -7.7 to 1.9, p=0.24) and RWA was not found to vary significantly over time (*p*= 0.55) (see Figure 6.3, below).

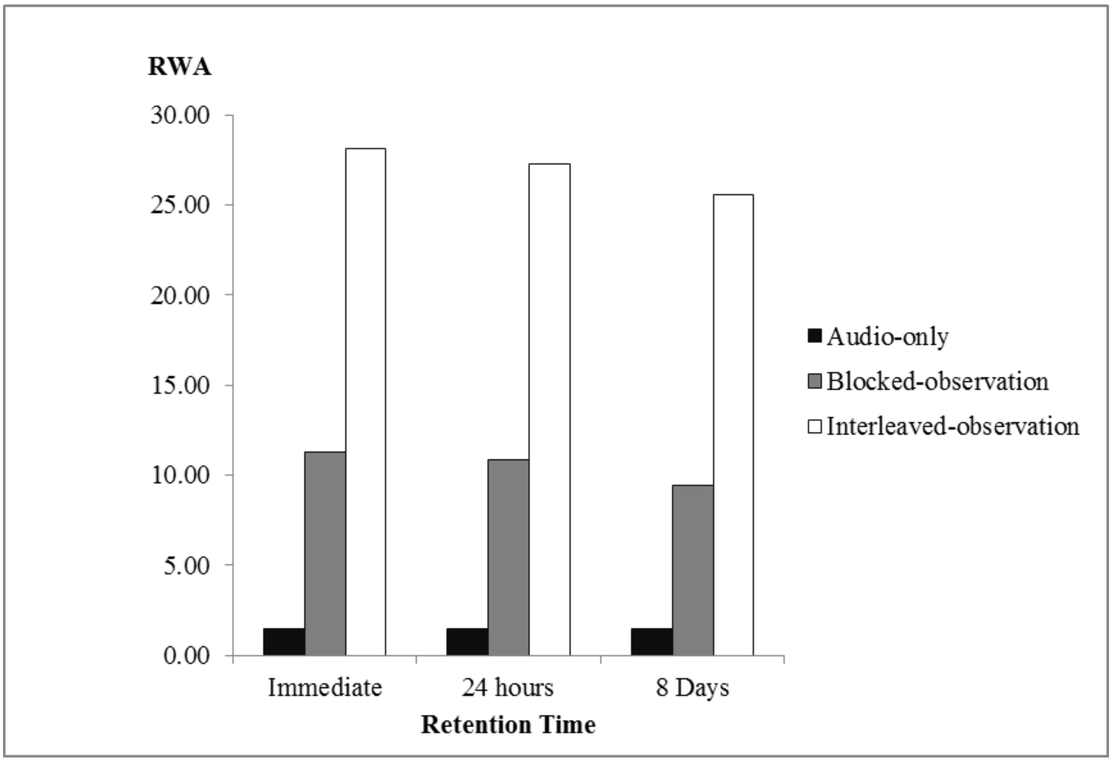

Figure 6.3. RWA (Rotation of Wrist Amplitude) mean values overtime, per teaching condition, for all students (proficiency levels I and II combined).

Post-hoc comparisons. In terms of post-hoc SIDR results, students submitted to the audio-only teaching condition had significantly different SIDR values when compared to students submitted to blocked-observation (*p*=0.02) and interleaved-observation (*p*<0.001) (who were not significantly different from each other, *p*=0.66) (see Table 6.4, next page). This relevant difference in SIDR in staccato learning outcomes of students submitted to an audio staccato example and verbal explanation, versus students that were submitted to verbal explanation alongside the observation and imitation of teacher's Mimic gesture, suggests that observation and imitation of teacher gesture translated into more efficient staccato learning.

Table 6.4. Post hoc comparisons of SIDR (Sound versus Inter-Onset Duration Ratio) and RWA (Rotation of Wrist Amplitude) across retention tests and teaching conditions.

Variables	Comparison	Difference Mean (95% CI)	Bonferroni adjusted P-value
SIDR	Retention test 1 vs. 2	0.02 (-0.02, 0.06)	0.82
	Retention test 1 vs. 3	0.06 (0.02, 0.10)	**<0.001**
	Retention test 2 vs. 3	0.04 (0.00, 0.08)	**0.03**
	A vs. B	-0.09 (-0.16, -0.01)	**0.02**
	A vs. I	-0.12 (-0.20, -0.05)	**<0.001**
	B vs. I	-0.04 (-0.11, 0.04)	0.66
RWA	Retention test 1 vs. 2	-0.4 (-3.6, 2.8)	1.00
	Retention test 1 vs. 3	-1.4 (-4.7, 1.8)	0.87
	Retention 2 vs. 3	-1.0 (-4.3, 2.2)	1.00
	A vs. B	9.3 (2.3, 16.4)	**0.006**
	A vs. I	25.6 (18.3, 32.9)	**<0.001**
	B vs. I	16.3 (9.1, 23.4)	**<0.001**

Note. A: audio-only condition; B: blocked-observation condition; I: interleaved-observation condition.

Put simply, students learned to play staccato more efficiently (shorter SIDR) when they have observed and imitated the teacher's gesture. The analysis shows a significant difference of SIDR (p<0.001) between retention test 3 (performed one week after the experiment) and both of the other two retention tests (performed respectively immediately after and 24 hours after the experiment). However, there were no significant differences between retentions tests 1 versus 2, or retention test 2 versus 3. This implies that although observing and imitating teacher's Mimic gesture yielded positive SIDR staccato learning outcomes, the effect of such observation and imitation diminished after eight days.

In terms of RWA (Table 6.4, previous page), there were significant differences in relation to students' specific teaching conditions. Students submitted to interleaved-observation produced movements with higher RWA in performing the Mimic gesture. The RWA values presented by students remained stable across retention tests, implying that (unlike with the sound measure), the effects of student observation and imitation of teacher Mimic gestures on students' movements remained stable for at least eight days after the experiment was conducted.

Retention and transfer test comparison

Sound. Initial examination of interaction between pairs of variables suggested no evidence of interaction between teaching condition and student group (p=0.86), nor between test and student group (*p*=0.72). However, there was slight evidence of interaction between test and teaching condition, although the result was not statistically significant (*p*=0.07). The test comparison results suggested no difference between retention and transfer tests for students submitted to the audio-only condition (*p*=0.96) or interleaved-observation (*p*=0.10). However, students submitted to interleaved-observation presented shorter SIDR values for both retention (b=0.13, 95% CI -0. 21 to 0.06) and transfer (b=0.09, 95% CI -0.17 to -0.02), when compared with the other two and, as such, played SIDR more efficiently in both tests than students submitted to audio-only and blocked-observation teaching conditions (given shorter SIDR and no significant difference between retention and transfer test results). Students submitted to blocked-observation presented statistically significant higher values of SIDR in the transfer test (b= 0.09, 95% CI 0.04 to 0.13) than for the retention test, and therefore performed better staccato quality at retention test 1 than in the transfer test (see Figure 6.4, below). SIDR values were not found to significantly vary between students' proficiency levels.

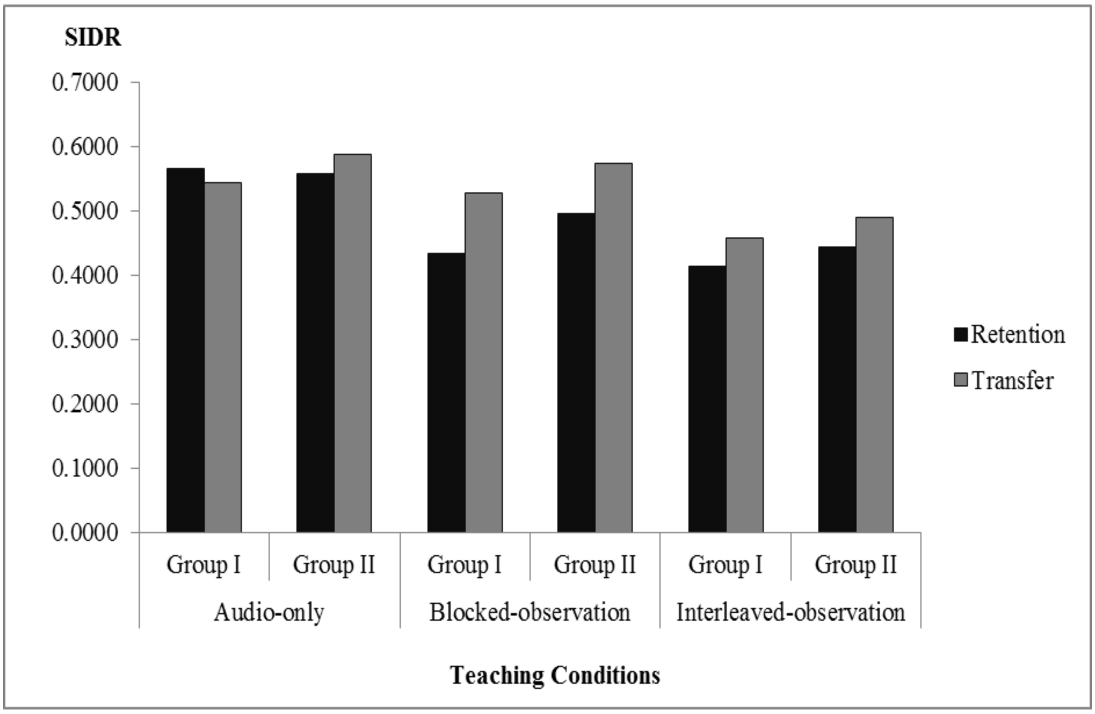

Figure 6.4. Comparison of SIDR (Sound versus Inter-Onset Duration Ratio) for retention/ transfer student proficiency level groups I and II.

Movement. Results concerning the interaction between pairs of variables suggested no significant interaction between test and student proficiency group (p=0.61) nor test and teaching condition (p=0.39). However, there was some evidence of interaction between teaching condition and student proficiency group (p=0.08), although again, this did not reach significance. Whilst the results suggested no difference in RWA between the retention and transfer tests (p=0.74) for each of the teaching conditions, there was however a difference in RWA in relation to students proficiency level: students from proficiency group I, submitted to teaching conditions B (b= 14.9, 95% CI 6.0 to 23.7) and C (b=26.1, 95% CI 17.3 to 35.0), both had higher RWA values than students submitted to audio-only condition (with values particularly high for interleaved-observation). Students in proficiency group II, submitted to interleaved-observation again had the highest values (b=29.3, 95% CI 19.6 to 39.0), but here there was little difference between the values of students submitted to blocked-observation and audio-only conditions. This suggests students submitted to interleaved-observation performed the Mimic gesture associated with learning to play staccato for this experiment more efficiently than students submitted to the other two teaching conditions. However, students in proficiency group I appeared to take greater learning benefit from blocked-observation, in relation to RWA outcomes, than students in proficiency group II (see Figure 6.5, below).

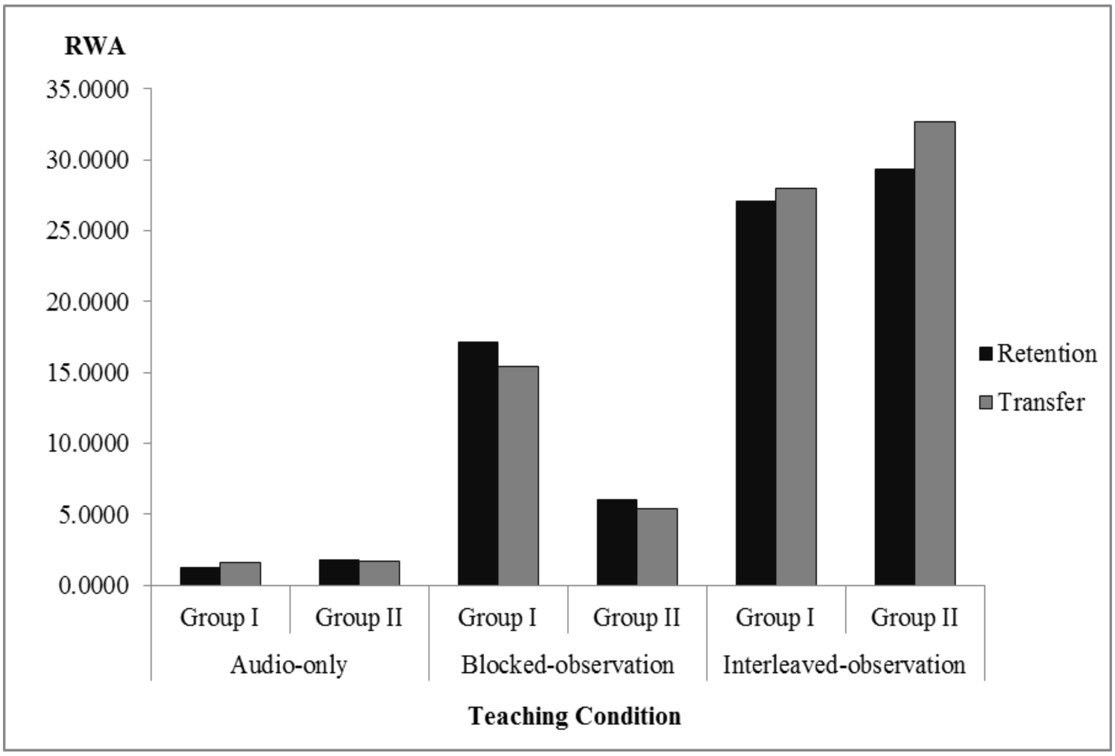

Figure 6.5. Comparison of RWA (Rotation of Wrist Amplitude) for retention/transfer student proficiency level groups I and II.

Post-hoc transfer and retention comparison. The differences between pairs of groups are summarised in Table 6.5 (below). Due to the previously observed interactions with other variables (above), the differences are quantified for different subgroups where an interaction was found. The results suggested that for SIDR, in the retention test subgroup there was a significant difference between students submitted to audio-only condition and the two other teaching conditions blocked-observation and interleaved-observation (who did not vary from each other). In the transfer test results, there were no strong differences between groups, but some evidence of difference between audio-only condition and interleaved-observation.

Table 6.5. Post-hoc comparisons of SIDR (Sound versus Inter-Onset Duration Ratio) and RWA (Rotation of Wrist Amplitude) with observed interactions with other variables.

Variables	Subgroup	Comparison	Difference Mean (95% CI)	P-value
SIDR	Retention test	A vs. B	-0.10 (-0.17, -0.03)	**0.02**
		A vs. I	-0.13 (-0.21, -0.06)	**<0.001**
		B vs. I	-0.04 (-0.13, 0.05)	1.00
	Transfer test	A vs. B	-0.01 (-0.10, 0.07)	1.00
		A vs. I	-0.09 (-0.18. 0.00)	0.05
		B vs. I	-0.08 (-0.17, 0.01)	0.13

Note. A: audio-only condition; B: blocked-observation condition; I: interleaved-observation condition.

6.2.3 Discussion

The findings of this study suggest an important role for the observation and imitation of teachers' Mimic gesture in terms of knowledge retention and transfer. More attention needs to be given to the interplay between auditory and motor channels in association to demonstrations from a teaching and learning perspective and in devising ways in which observation and imitation, can be strategically used for optimising learning effectiveness.

Piano students presented considerably greater learning outcomes when submitted to teaching conditions in which they observed gestures and were requested to imitate the gesture. This was in opposition to students that were only provided with an audio-only representation and verbal explanation of the task to be performed. As such, relying only upon audio representation and verbal explanations of musical tasks is less effective for students learning to play piano in proficiency levels between pre-grade and grade 8: students' observation and imitation of teacher audio-visuo-motor demonstration produced greater learning outcomes, evidenced by shorter relative note durations (in accordance with the staccato definition) and increased wrist rotation (in accordance with the Mimic gesture used for this specific study). Regarding proficiency levels another study involving skilled pianists showed alternative results (Brown & Palmer, 2013). Here auditory imagery aided performers in learning correct pitch sequences at encoding and in executing sequences with greater temporal regularity at retrieval. These contrasting findings reveal the importance of a greater understanding of instrumental music perceptual learning aspects of students from the earliest stages of learning to grade 8, in comparison with skilled musicians, in order to establish particular teaching learning strategies that prioritise student learning outcomes. So whilst there is a considerable body of research focused upon skilled musicians, there remains a distinct lack of scholarly attention in the learning practices of musicians at the earliest stages of learning.

The fact that this study population benefitted greatly from observation and imitation of teacher audio-visuo-motor demonstrations, in opposition to an audio and verbal only stimuli, appears to agree with suggestions of an auditory and visual action-observation musical mirror system (Bangert et al., 2006; Haslinger, Erhard, Altenmuller, Schroeder, Boecker & Ceballos-Baumann, 2005), in contrast to only auditory (Ohnishi, Matsuda, Asada, Arugal, Hirakata, Katoh & Imabayashi, 2001) or only visual (Hasegawa et al., 2004). Elsewhere, a transmodal audiovisual network was found to be more strongly activated in pianists against non-musicians during passive observation of musical motor activity that could functionally couple motor observation, auditory feedback, and imitation for learning of musical skills. However, such specialised systems in development during long-term piano training, and appointed as an important element for the highly specific musical 'intelligence' in professional musicians (Haslinger et al., 2005), has the potential to evolve differently in relation to specific teaching and learning strategies (as seen here, students taught with the absence of gesture, showed significantly different results when compared with the gesture-present condition). And the following findings also support this claim: RWA (range of wrist amplitude) values remained stable during the three retention tests for each group, whilst SIDR (sound) values significantly increased over time. This seems to imply that motor learning is stable across a time span of eight days, but auditory learning may require a lesser time-span between rehearsals in order to be maintained. Further investigations are required to determine what the optimal time-span could be. Despite working in parallel, moreover, auditory and motor perceptual channels cannot be assumed to develop in synchrony. They seem to require specific teaching strategies in order to develop side-by-side. Thus the neurobiological basis of imitative, observative, and auditory-based teaching and learning needs to be investigated as not all musical and non-musical training can be assumed to produce successful learning results.

It is striking that there were no differences in terms of sound and physical movement across proficiency levels in the retention tests, and that only one difference was found regarding students submitted to blocked-observation, in the comparison of retention test 1 and transfer test. Regarding the retention tests results, students in proficiency group II (grades 4-8) are in what can be considered as a 'middle' learning stage: they are not beginners and the next stage after grade 8 is a stage of a considerable skilled performance level. It would be expected that higher levels of musicianship would have generated alternative results. However, despite being at an intermediate level of ability, their results in terms of sound quality (SIDR) or range of wrist amplitude (RWA) at the retention tests did not differ from students in the lower proficiency level group (pre-grade to grade 3). Reasons for this could be unfamiliarity with a staccato task that involved a new motor pattern to be learned and in which the entire study population was in a similar new learning situation. Thus the absence of previous motor control tendencies, phase relationships (e.g. Kelso & Zanone, 2002) or similar cognitive processes (e.g. Lee, 1988) can be suggested as possible reasons for such results. Nevertheless, it would have been expected that higher levels of musicianship would have provided proficiency group II with transferable strategies that could possibly have contributed to better results, in comparison to group I. This turned out not to be the case.

The difference found in terms of comparison of retention test 1 and transfer test, suggested that students in proficiency group I (aged 5 to 14) took greater learning benefit from blocked-observation (regarding physical movement) in comparison to students in proficiency group II (aged 13 to 44). Both groups were submitted to the same teaching condition so this difference can be attributed to age, learning stage and developmental factors. This is in synchrony with previous research stating that as a result of observation, children show a greater tendency to achieve movement outcome goals (e.g. task accuracy) than adults, who tend to focus more on matching existing intrinsic dynamics with the observed task dynamics (Ashford, Davids & Bennett, 2007; Wohlschläger, Gattis & Bekkering, 2003). As such, it is important to understand that children and adult observers possess individual differences in their intrinsic dynamics, which may require a differential emphasis on movement outcomes and movement dynamics (Ashford et al., 2007). Teaching in contexts where there are specific movement outcomes and dynamics, such as instrumental music, dance, sports, arts and crafts needs to take such differences into account and devise research-based strategies that account for age, developmental stage and musical proficiency level, among other factors.

Whilst observation and imitation were both present in both teaching conditions involving gesture, and both teaching conditions yielded positive learning outcomes, greater learning effectiveness resulted from observations that were intercalated with students' immediate imitation of researcher's demonstrations. An explanation of why students in the intercalated observation condition demonstrated greater learning outcomes could reside in the fact that both perceptual and motor processes are involved in mimicry and imitation; and as pointed out by Beckkering (2002), they may exert influence over each other. However, a more precise explanation can be found in the Associative Sequence Learning hypothesis, based upon prediction and error (Cook et al., 2010; Cooper, Cook, Dickinson & Heyes, 2013; Heyes & Ray, 2000), where it is suggested that contingency (experiencing a predictive relationship between observation and execution) is important for imitation. This is in opposition to the Hebbian learning hypothesis (Keysers & Perrett, 2004) that suggests that the mirror system depends exclusively on contiguity (observing and executing the same action at the same time). Indeed, repeated sets of intercalated observations and imitations in this study appeared to provide a higher predictive relationship between observation and execution, and therefore greater learning outcomes. Such learning outcomes spanned across time, with students submitted to interleaved-observation performing higher quality staccato both at retention and transfer test in terms of sound and physical movement, in opposition to the other two groups. Students submitted to blocked-observation presented a significant decrease in their staccato performance quality on transfer tests, evidenced by higher SIDR values, in comparison with their specific retention test results.

Although this study ascribes importance to the role of observation and imitation of teachers' Mimic gestures where their embodiment of abstract concepts facilitates the intended learning outcome, it is important to be aware of effects of incongruent gesture representations. Elsewhere, these were shown to cause a stroop-like effect that slowed down reaction times, and in which the incongruent gesture activated an internal motor representation that interfered with the motor execution of the response gesture (Prinz, 2002; Sturmer, Aschersleben & Prinz, 2000). Thus gesture is an effective teaching and learning element whenever correctly used and this points to the need of investigating gesture in terms of learning effectiveness and for teacher training programmes to include elements of empirically tested gestural pedagogy. As this study shows, other factors that need to be considered when planning learning programmes involving gesture that constitute possible research avenues for specific pedagogical contexts are: consideration of the appropriateness and suitability of the type of gestural representations alongside the characteristics of the skill being learned, not only in terms of required learning outcome but also in relation to students' specific circumstances such as age, proficiency level, the quality of the gestural demonstration in relation to specific learning outcomes and specificities of different pedagogical contexts.

6.2.4 Conclusion

The findings of this study suggest not only an important role for the observation and imitation of teacher's gesture for students' learning (in terms of knowledge retention and transfer), but also that certain gestural teaching and learning conditions (involving different combinations of observation and imitation elements) are more effective than others. Greater learning effectiveness resulted from observations that were intercalated with students' immediate imitation of teacher's Mimic gestures, in comparison to a block of observations followed by a block of imitations. In contexts where the intended learning outcomes involve the embodiment of abstract concepts in a motor activity, ascribing certain degrees of effectiveness to certain gestural teaching strategies implies two things: firstly, a need to consider gesture as communicational and also as an integral aspect of the content to be learned; and secondly, that empirical work should be carried out to unravel specific gestural performance demonstrations that can enhance motor learning across group-specific pedagogical contexts while accounting for circumstances such as age, proficiency levels and other relevant factors.

The findings point to a need for looking at auditory and motor learning as parallel perceptual channels in which particularities for side-by-side development need to be devised in specific contexts and appropriate educational strategies considered from a point of view of student learning outcomes. It is only upon recognition of the role and importance of gesture and the interconnectedness of perceptual and motoric aspects that a much needed embodied and empirical gestural pedagogy can be developed for teaching conceptual and embodied practical elements directed not only to students, but also to prospective teachers.

Chapter 7

Conclusions and future directions

This thesis set out to investigate the roles of gesture in piano teaching and learning. Despite physical gestures being an integral and essential element both for the establishment of communication between teacher and student, and for actively playing a musical instrument, gestures have nevertheless been consistently overlooked by research in the instrumental music teaching and learning context. However, the study of gesture is of crucial importance for the establishment of an empirically based piano and instrumental pedagogy, as it can provide a multiplicity of insights relevant to improving teaching and learning experiences in this context. Among the manifold benefits, these insights can help to provide: better understandings about how effective communication (verbal, gestural, musical) can be established between the teacher and student dyad in the process of musical communication; more informed acknowledgements of how specific educational practices in certain learning contexts can influence both student learning and musical performance; and, ultimately, the provision of insights that instrumental music teachers' can take forward to optimise teaching practises that are highly gestural and focused upon promoting effective student learning. The contribution of this thesis is aligned with its central, empirically scrutinised argument that given gesture's essential and integral status for music making, and the fact that music making is in itself rooted in educational and cultural practices, it logically follows that instrumental music teachers' gestures have an important role to play in the communication of symbolic and functional musical knowledge to students. The investigations carried out to ascertain the credibility of this statement focused exclusively upon piano teaching and learning undergone in formal educational settings, on a one-to-one basis in the western classic music tradition; and they were driven by two research questions:

1. What is the role of teachers' physical gestures in the piano teaching context – in terms of communication in general, and in the communication of musical symbolic and functional knowledge across students' skill levels?

2. What implications can teacher's gesture have on student learning outcomes?

In this conclusive chapter I retrace and combine the main areas touched upon by my empirical work, beginning by providing answers to the main research questions alongside a brief contextualisation of such findings in terms of wider-literature and -relevance (Section 7.1). This is followed by considerations on the findings theoretical and practical implications, suggestions for future research directions, and a statement on this work's limitations (Section 7.2). Lastly, a final commentary and judgement on the research main statement wrapped in the form of a conclusive remark brings this work to a close (Section 7.3).

7.1 Empirical findings: answering the research questions and contextualisation

In this section I will synthesise the empirical findings to answer this thesis's two main research questions. Findings that specifically pertain to the research questions are presented in bold below in addition to a justification of how they effectively contribute to answering the proposed question. Accompanying this is a brief contextualisation and consideration on the impact of this work's specific findings for the wider research landscape.

With regards to the first research question: 'What is the role of teachers' gestures in the piano teaching context – in terms of communication in general, and in the communication of musical symbolic and functional knowledge across students' skill levels?'

Teachers' gestures reveal aspects of their own thinking. The correlation found between teachers' teaching behaviours and their gesture types (as reported in the empirical investigation carried out in Chapter 3) suggests a relationship between teachers' didactic intentions and the types of gestures they use to communicate information to the student. The uneven use of gesture by teachers across teaching behaviours suggests that teachers' gestures reveal aspects of their own thinking. This finding chimes with research in psycholinguistics, which states that teachers' gestures may index their own cognitive states and serve cognitive functions for speakers, such as: aid in the retrieval of words from memory (Rauscher et al., 1996); reduction of cognitive burden due to allocation of effort placed in other tasks (Goldin-Meadow et al., 2001); provision of an alternate representational format in addition to speech (Goldin-Meadow, 1999); and support in accessing new thoughts (McNeill, 1992; Goldin-Meadow, 1999). Such assumptions led to McNeill's (2005: 3) argument that the synchrony of speech and gestures creates the conditions for 'an imagery-language dialectic that fuels *thinking* for speaking as it seeks resolution'. The work carried out in this thesis provides a contribution to the above avenue of research by relating teachers' didactic intentions – expressed in the form of teaching behaviours – with teachers' gestural performance; and it finds a relationship at this level amongst three teachers from different European countries. If teachers' gestures can be considered as revealing their thinking and cognitive states, then there is a chance that teachers' gestures could be an indicator of teaching knowledge/experience, and can perhaps determine teachers' efficiency levels and their perceptions of student conceptual levels. Furthermore, this finding implies that students may become acquainted with teachers' thoughts not only in relation to 'what they say' but also in 'how they gesture'; and this might in itself have significant learning implications. By probing and interrogating this finding more fully than was possible in the parameters of this narrow study, the wider import of this may yet be realised.

Teachers' spontaneous co-verbal gestures (McNeill, 1992, 2005) serve not only day-to-day communicative functions, but also aid in the process of communicating musical knowledge. In research work undergone for the purposes of this thesis, teachers were frequently observed performing spontaneous co-verbal gestures (as defined by McNeill 1992; 2005). Spontaneous co-verbal gestures communicative functions have been intensely scrutinised over the last three decades, and strong evidence regarding their communicative roles has been unearthed (see Section 2.3). The fact that teachers' were observed as ubiquitously using spontaneous co-verbal gestures in this context (see Chapter 3 and 4) was indeed expected, given findings on the communicational roles of such gestures reported elsewhere (see Goldin-Meadow, 1999; Kendon, 2004; McNeill, 1992, 2005). It seems that this can be taken to imply day-to-day communicative functions for the use of such gestures in this context. However, my results do suggest that two categories of spontaneous co-verbal gestures (Deictic and Iconic) were observed to have specific functions in the processes of communicating musical knowledge *in addition to* day-to-day communicative roles. Roughly 20% of the Deictic gestures observed in the investigation (reported in Chapter 3) were linked to musical modalities (such as singing, marking the beat, etc.), and were not always associated with verbal content. Deictic gestures were also shown to have an important role in terms of ascribing meaning to the icons/symbols in the score, and their translation to a self-functional musical experience, engaging mind and body. The overall frequency of Deictic gestures (in studies reported in Chapter 3 and 4) suggests the need for a closer consideration of this gesture type in the context of instrumental music teaching. Moreover, Deictic gestures occurring *without* verbal language (and with a strictly musical behaviour) could be considered as 'spontaneous co-musical deictic gestures'; and, as such, not limited to the use of verbal language. At this level, the results prompted by this thesis may question assumptions from the field of psycholinguistics where Deictic gestures are regarded as being specifically *co-verbal*.

Iconic gestures were used to trace the shape of the musical symbols in the air. Teachers occasionally performed Iconic gestures whilst pointing to various symbols/icons of music notation contained in the score, as if taking the signs in question 'out of score' to a physically performative arena; they also did so at times in the absence of verbal content. Teachers' varying uses of Iconic gestures across student proficiency levels seems to point to teachers' increased focus on motor-functional knowledge, with advancing student proficiency levels in terms of gearing the learning towards a students' understanding of the activity in itself, in a meaningful way. The above occurrences of Deictic and Iconic gestures appear to concur with Alibali and Nathan (2006) and Lakoff and Núñez (2001). These studies suggest that teachers use gestures in order to 'ground' their instructional language, arguing that teachers link their words with real-world and physical referents such as actions, objects, diagrams, or other inscriptions through gesture. These authors argue that gestural grounding contributes to the information conveyed in the verbal channel becoming more accessible to students, advancing that in lessons involving different types of representational material different types of gestural grounding will likely be used. Given the findings of this thesis, it is also possible to say that (in relation to spontaneous co-verbal gestures) (McNeill 1992, 2005) Deictic and Iconic gestures may both assume an iconic referential that, in the context of instrumental music education, has an ultimate pedagogical goal of meaning creation. That said, the nature and effectiveness of teachers' gestural performance versus students' musical meaning generation and learning outcomes still requires further investigations. To psycholinguistics, this finding suggests a need for reconceptualising the functions of gesture types within specific areas of knowledge while evaluating gesture alliance to verbal elements more cautiously; and to the fields of music education and communication, unique insights are provided regarding the roles of Deictic and Iconic gestures in the process of musical communication.

Teachers avail of specific musical gestures, here termed as *spontaneous co-musical gestures* to communicate symbolic and functional musical knowledge. Besides using spontaneous co-verbal gestures (McNeill, 1992; 2005) as reported above, teachers were observed performing other gestures that could not be classified using McNeill's co-verbal gesture classification or Jensenius et al.'s (2010) musical gesture classification. These observed musical gestures were named in this thesis after general music literature, put together as a categorisation of piano teachers' gestures for the first time and were designated as 'spontaneous co-musical gestures' in lieu of the parallels identified between co-verbal and co-musical spontaneous gestures (see Chapter 3). Considered alongside the aforementioned communicative parallels, the empirical investigations reported in Chapters 3 and 4 suggest that spontaneous co-musical gestures have specific functions in the process of communicating symbolic and functional musical knowledge. Moreover, in each of the gesture types identified symbolic and functional communicational elements related to the teaching and learning process appear to overlap. For instance, Mimic gestures (in Chapter 3 and 4) appeared to contribute to teaching the functional aspects related to learning to play and how to play piano. But at the same time, this gesture has the potential of promoting a student's creation of a symbolic and abstract repertoire of gestural memories, and to promote an imagery-music-dialectic between teacher, student and the musical work in development; the same can be said about the other types of spontaneous co-musical gestures. Hence the intense communicative scenario of teaching to play a musical instrument is paired with a dual and intricate symbolic and functional character of each gesture that cannot be easily disassociated. Moreover, in communicational terms, the uneven distribution of teachers' gesture types between teaching behaviours suggests that certain gestures have emerged in the teachers' approach as being more effective for communicating particular kinds of musical knowledge to the students: Co-verbal Beats, Touch and Conducting Style were observed more often during Modelling than during other teaching behaviours, while Iconic gestures occurred more during Giving Information and Giving Practice Suggestions/Advice. Several theoretical and practical implications stem from this finding. Firstly, the piano teachers' gesture categorisation is a stepping-stone for promoting and enabling empirical research into this emerging field of studies. Secondly, the findings related to each spontaneous co-musical gesture type provide useful insights into how teaching and learning processes influence physical movement and gestural features during musical performance, and provide insights that can guide the teaching process. However, recommendations for teaching that might emerge from these findings should only be brought forward with an understanding of each of the aforementioned gesture types for student learning, and this should be a research priority. Thirdly, this finding can initiate a debate among professionals on gestural matters related to instrumental music tuition with implications in terms of evaluating the present pedagogical practice, not to mention prompting recommendations for future research into the design and administration of music performance tuition.

Teachers' gestures are an integral component of teachers' scaffolding. This work demonstrates that the encoding of musical communication occurs through verbal and gestural scaffolding processes. This was demonstrated in Chapter 4, where teachers' where shown to be sensitive to piano-learners' conceptual levels, and to adapt their gestural approaches accordingly, through the following findings: a statistically significant difference in teachers' combined gestural performance across student proficiency levels (exceptions to this are in relation to Musical Beats and Playing Piano gestures); a tendency for higher gestural production of certain gesture types for certain student proficiency levels, consistent with most of teachers' individual results (except for Musical Beats and Playing Piano gestures); and qualitative differences in the use of Deictic and Touch gestures across student proficiency levels. Additionally, the investigation in Chapter 6 suggested not only an important role for the observation and imitation of teacher's gesture for students' learning (in terms of knowledge retention and transfer), but also that certain gestural teaching and learning conditions (involving different combinations of observation and imitation elements) are more effective than others. Considered together, this reveals that more attention needs to be given to scaffolding teaching strategies, and that there is scope for optimising teachers' gestural scaffolding performances in the face of research geared toward finding teaching gestural strategies best suited for teaching/learning specific intended pedagogical elements. In fact, previous research into scaffolding processes in the instrumental music context ascribed an important role to both verbal (e.g. Adachi, 1994; Kennell, 2002; Saxe et al., 1984; Wood et al., 1976) and non-verbal modelling (e.g. Dickey, 1992; Goolsby, 1996; Sink, 2002; Wang, 2001). Regardless, little attention has so far been given specifically to the so-called non-verbal modelling aspects of teaching to play a musical instrument, particularly in terms of students' effective learning outcomes. Even in the field of psycholinguistics, for instance, there is scant research on the topic (exceptions are Alibali & Nathan, 2006; Wang et al., 2001). The work developed in this thesis raises further awareness of the need for more attention to be given to teaching gestural scaffolding strategies given the specific results that knowledge is encoded through verbal and gestural scaffolding processes which yield different levels of students' learning effectiveness. These findings draw attention to the need for similar, complementary research into scaffolding based on verbal communicative channels with gestural considerations.

Turning towards answering the second research question ('what implications can teacher's gesture have on student learning outcomes?') it is clear that teachers' gestures have important implications for students' learning.

Teachers' gestures have a role in the embodiment of abstract concepts in the essential motor functional activity of playing a musical instrument. This was evidenced in the empirical investigation carried out on Chapter 6, which was dedicated to evaluating the role of teachers' Mimic gestures for students' learning to perform a certain type of staccato. The findings suggested an important role for the observation and imitation of teachers' Mimic gesture in terms of students' knowledge retention and transfer. In this study, piano students presented considerably greater learning outcomes when submitted to teaching conditions in which they observed a predetermined Mimic gesture and were requested to imitate it. This was in opposition to students that were only provided with an audio-only representation and verbal explanation of the task to be performed. Students' learning outcomes were evidenced by shorter relative note durations (in accordance with the staccato definition) and increased wrist rotation (in accordance with the Mimic gesture used for this specific study). This finding aligns with research from a variety of different contexts where gesture has been show to aid and support learning, such as mathematics, sports research, physical education, neurology, and social cognitive neuroscience, as discussed throughout the previous chapters of this thesis. Despite, however, the widespread use of teachers' gestural demonstrations and students' imitation of teachers' gestures, there has been a lack of considerations encompassing student learning outcomes from teachers' gestural demonstrations in this context. The study here undertaken and reported in Chapter 6 reveals that teachers' gestural demonstrations exert a relevant influence upon students learning piano, and also implies that gestures used by learners do play a significant role in learning. The relevance of this finding resides in the awareness of the importance of gesture (performed by teachers and students) for the learning process, and more research needs to be undertaken to cultivate deeper knowledge about how certain gestural demonstration teaching strategies can impact upon learning. Such knowledge is essential for evaluating, improving and systematising instrumental music teaching.

Certain gestural teaching and learning conditions involving different combinations of observation and imitation are more effective than others. Chapter 6 also revealed that greater learning effectiveness resulted from observations that were intercalated with students' immediate imitation of teacher's Mimic gestures, in comparison with a block of observations followed by a block of imitations. This finding seems to accord with the argument proposed by the Associative Sequence Learning hypothesis, based upon prediction and error (Cook et al., 2010; Cooper et al., 2013; Heyes & Ray, 2000), where it is suggested that contingency (experiencing a predictive relationship between observation and execution) is important for imitation. In this study, repeated sets of intercalated observations and imitations appeared to provide a higher predictive relationship between observation and execution, and therefore greater learning outcomes spanning across time, in opposition to the other two groups. It appears important to note that despite the important role attributed to observation and imitation of teachers' Mimic gestures here (for the embodiment of abstract concepts), elsewhere it has been shown that incongruent gesture representations activated an internal motor representation that interfered with the motor execution of the response gesture (Prinz, 2002; Sturmer et al., 2000). Therefore, gesture is an effective teaching and learning element whenever used appropriately; however, such 'appropriateness' needs to be empirically investigated, and teacher training programmes would need to include elements of empirically tested gestural pedagogy. Within the results it has generated, this thesis has shown empirical evidence that gesture (performed by teachers and students) is important for student learning outcomes in the instrumental music teaching and learning context. It has, moreover, clearly demonstrated that in contexts where the intended learning outcomes involve the embodiment of abstract concepts in a motor activity, there is a need to consider gesture as both communicational and an integral aspect of the content to be learned.

7.2. Implications, new research directions and limitations

Several theoretical and practical implications arguably arise from this work. To begin with, the parallels here established between spontaneous co-verbal gestures (McNeill 1992; 2005) and the spontaneous co-musical gestures (observed, defined and categorised in this research) have relevant implications not only for piano pedagogy but also for fields of study dedicated to studying processes of musical communication. Earlier attempts of establishing such parallels (e.g. Fulford & Ginsborg, 2013; Wanderley & Vines, 2006) lacked considerations regarding the specificities of musical gestures – given the deeply rooted assumption that gestures used in music performance would mirror speech patterns (e.g. Davidson, 2005). This thesis demarcates a new position in relation to this research by: focusing on the specificities of musical communicative gestures in terms of their own production features (gesture shape/form); looking at the nature of the musical communicative process taking place in the instrumental music teaching and learning context; and speculating that gestures observed in the context of this research may have a different communicative nature than (a) gestures used in the context of musical performance, and (b) co-verbal gestures as defined in the field of psycholinguistics (see Goldin-Meadow, 1999; 2003; Kendon, 2004; McNeill 1992; 2005). Such insights resulted in the establishment of a piano teachers' gesture categorisation that takes full account of gesture form, associated verbal content, meaning(s) and function(s). This categorisation is easily applicable to other forms of instrumental music teaching, and can be adapted and extended to suit a multiplicity of research purposes. Both the devised categorisation of teachers' gestures and the research framework used in the three undertaken investigations (in Chapters 3, 4 and 6) can be extended to other types of one-to-one music instrumental teaching/learning scenarios such as woodwind, string, brass and vocal teaching, as well as expanded to encompass teaching and learning of small ensembles and comparisons with conductors of small/large ensembles. Such future work could focus on trying to understand the nature and effectiveness of the relationship between teachers' didactic intentions and the gesture types they use to communicate musical knowledge to students across students skill levels and ages. In so doing, it appears relevant to grasp deeper insights about the role of each gesture type (co-verbal and musical gestures) in the encoding process of musical communication in relation to students' interpretative meaning construction. The practical implications of such extensions are wide ranging and they too merit attention in order to raise knowledge that can contribute to an informed teaching practice in addition to the potential benefits related to improving the quality of students' learning experiences.

Through this conceptual and empirical work it is clear that the intense communicative scenario of teaching to play a musical instrument paired with the dual symbolic and functional aspect of gestures requires a specialised gestural analysis, distinct from the field of music performance. The context of instrumental music teaching needs to be understood in itself and not through the eyes of research focused solely upon performing to an audience. One of the differences resides in the fact that whilst gestures used in musical performance situations are often the result of a carefully rehearsed process (and as such, are rarely spontaneous) (Wanderley & Vines, 2006), so it is in the instrumental music pedagogical environment that the 'rehearsal process' is developed. Such a process occurs as part of a musically spontaneous, communicative interaction between teacher and student. These insights led me to transpose McNeill's (2005) ideas of 'imagery-language-dialectic' to an 'imagery-music-dialectic', in which teachers' gestures can be considered as integral spontaneous components of music when synchronous and co-expressive with music. Spontaneous co-musical gestures can offer a conceptual and practical basis for theorising processes of musical communication in the instrumental music classroom. Further research dedicated to understanding the nature and effectiveness of gestures performed by teachers, particularly in the course of gestural demonstrations in relation to student learning outcomes, is needed; and this can produce substantial outcomes for instrumental teaching and learning practice. Moreover, the findings of this thesis challenge psycholinguistics' core idea that spontaneous hand gesticulations occur only side-by-side with speech, as teachers in this setting performed spontaneous hand gestures in the following situations: alongside speech; alongside music making accompanied by speech; and also in music making without speech. It is apparent that more attention needs to be devoted to understanding the intersections between processes of day-to-day communication and musical communication, as they seem to share communicational aspects, and at the same time have their own specificities.

The fact that the process of musical communication between teacher and student is embedded in a scaffolding approach through which musical interpretative meaning is developed (through verbal and gestural signs), is also strongly suggestive of a new layer to pedagogical and research considerations. In terms of pedagogical practice, it is relevant to understand how the encoding of musical communication is developed through verbal, gestural and communicational channels more deeply. As such, earlier attempts to explain and study teachers' scaffolding processes, mainly through the analysis of verbal content (e.g. Adachi, 1994; Kennel, 2002) need to be augmented by considerations about teachers' gestural scaffolding approaches, when focusing on students' learning efficiency in relation to teaching. There is, additionally, a need to consider gesture as both a communicational and integral aspect of the content to be learned; and, as such, empirical work needs to be carried out to ascertain specific gestural performance demonstrations that can enhance motor learning across group-specific pedagogical environments whilst taking into account factors such as students' ages and proficiencies. Greater attention also needs to be given to the interplay between auditory and motor channels in association to demonstrations from a teaching and learning perspective, and into devising ways in which observation and imitation can be used strategically for optimising learning effectiveness. This is especially the case given that – as shown by the findings of the study reported in Chapter 6 – reliance upon only audio representation and verbal explanations of musical tasks has considerably lower levels of effectiveness for students' learning compared to the use of gestural demonstrations. Understanding gestural performance effectiveness in relation to students' learning effectiveness seems like the next logical step for research into establishing a gestural pedagogy for this context. Future investigations could also approach this area by viewing the data from students' perspectives, using and extending the framework presented here to accommodate instrumental tuition in other musical instruments (including vocal teaching). And as the teachers here were all experienced females, perhaps future research might also explore variables such as teacher proficiency levels and/or genders – how might the gestural approach of a relative novice compare with those with more experience? What gestural differences might be observed between male and female teaching styles?

In light of the results generated here, it is also relevant to investigate differences of effectiveness of certain gesture types within different teaching behaviours. Focusing upon gestural interaction between teacher and students, and viewing the data from the perspective of students and their gestures as part of music-making might too provide wide-ranging information for areas such as music psychology, education and performance. This work's suggestions of an important role of gesture for student learning determines that a priority focus should be directed at establishing a gesture pedagogy for this context, one based on empirical findings that can be taught to prospective instrumental teachers at a university level, and hopefully contribute to enhance teaching efficiency.

Considering such potential for future research naturally illuminates some of the limitations of this study. With more resources and time the small population sample of three teachers and three students (Chapter 3) and twelve students (Chapter 4), could clearly be enlarged. The teacher population in this study was comprised of experienced individuals, and as such more research is required in order to better understand what teaching differences there may be between novices and more experienced teachers. The student population encompassed proficiency levels from pre-grade 1 to grade 8, and it is possible that a focus upon more fluent students would yield more varied results, in terms of teacher gesture and musical embodiment. Expanding upon the time of analysis might also sharpen results, given that only the first 7 and 3 minutes of each teaching session were analysed (respectively in Chapters 3 and 4). Finally, the focus on teachers' gestures in a piano teaching/learning context implies that specific contextual adaptations may be required when applying the spontaneous co-musical gestures classification to other contexts of instrumental music teaching/learning. These findings are particular to the western classical music tradition, and considerations about other musical cultures need also to account for contextual specificities.

7.3 Conclusive remarks

This work responded to its predetermined research questions. However, the fact that it also established a fresh research framework from which future research can depart brings with it an array of gesture-related questions – questions which are intrinsically related to the gestural processes of instrumental music teaching and learning. Returning to the central argument posed at the beginning of this thesis, it is possible to state that instrumental music teachers' gestures have an important role in the communication of symbolic and functional musical knowledge to students; and it is possible to conclude that teachers' gestures serve three main roles: they reveal aspects of teachers' own thinking; they have general communicative functions in day-to-day human communication; and perform specific musical pedagogical functions that are sensitive to gesture types. In the intensively communicative scenario of teaching to play a musical instrument, each gesture type is paired with a dual and intricate symbolic, and a functional character that cannot be easily disassociated. Such dual and intricate gestural functionality contributes to students' musical interpretative meaning construction in a gestural scaffolding approach.

Teachers' gestures have a role in students' embodiment of abstract concepts in the essential motor functional activity of playing a musical instrument, and, consequently, in music making. Such embodiment processes ultimately result in students' acquisition of symbolic and functional musical knowledge – in a process of musical enculturation. It is through this process that students' encoding of musical communication (through verbal, gestural and musical communicative channels) and interpretative meaning construction is developed. This work demonstrates how different gesture types contribute to this process. Although the investigations were carried out in a piano teaching and learning context, these gestural roles could form the basis for analyses of other instrumental teaching contexts. The work developed here reveals that, in this context, social, communicative and embodied processes overlap; and that embodiment is not only reflected in the nature of the social and communicative interactions that take place in this context, but is also intimately related to the teaching and learning of the musical material. Such an acknowledgement brings with it a decisive dimension to instrumental music pedagogy: the task of developing an empirical gestural pedagogy for the benefit of both teacher and student alike.

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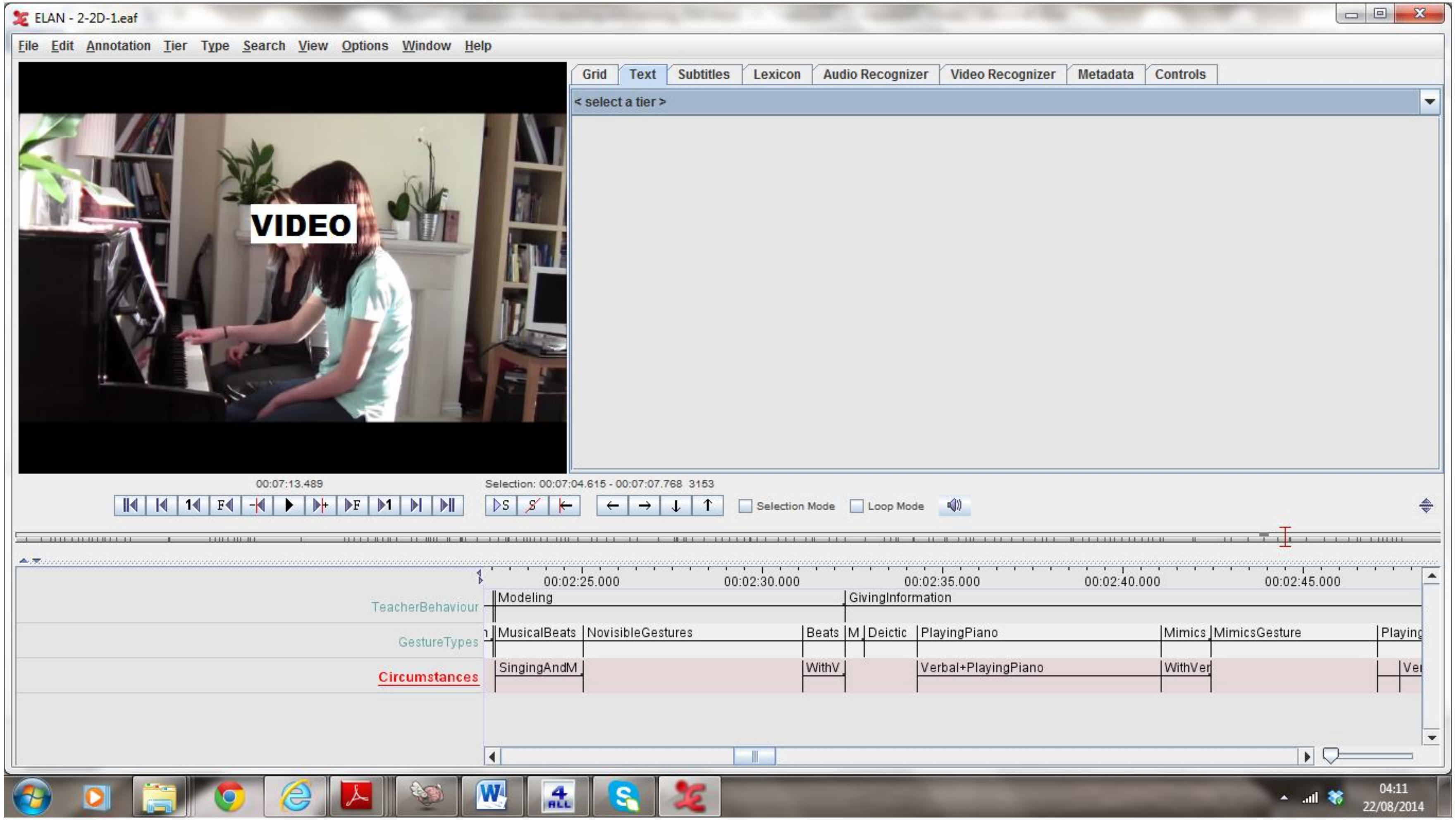
Appendix A

ABRSM minimum skill requirements for piano grades 1 to 8, in 2011-2014 period

Appendix B

Print screen of annotated file using Elan Software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Appendix C

Research ethics application for the investigations reported in Chapters 3 and 4.

School of Creative Arts

Queen's University of Belfast

Research Ethics Application

You must complete the form in full and in typescript. Please look to the guidance notes and undergraduate notes when completing this form. Failure to fully complete the form may delay the process of considering your application. Not all questions may be relevant, if they are not answer with N/A. Do NOT leave questions blank.

The following documents are required to consider your application. Please tick each checkbox to indicate this information has been included.

1)	Completed Research Ethics Application form (this form)	X	For undergraduate applicants submit 2 copies of each. All other applicants submit 5 copies.
2)	Participant Information sheet (footnote 1)	X	
3)	Participant Consent form (footnote 2)	X	
4)	Research protocol (footnote 3)	X	
5)	Unpublished questionnaires	X	

If relevant

6) Any other information to support the application (1 copy) ☐
List details

Is this project (tick as appropriate)

Undergraduate research	☐	MSc research	☐	MA research	☐
BMus. Research	☐	BSc research	☐	PhD research	X

Undergraduates please submit this form, when complete, to your supervisor.

Your research may not begin until you have received notification from the School of Creative Arts Research Ethics Committee, or your supervisor.

Applicant Information

A1 **Project Title**:
Title: the role of body movement in instrumental musical teaching/learning (Final thesis title still to be decided according the project's further development).

A2 **Researcher(s)**:
Lilian Simones, PhD student.

A3 **Supervisor for UG/PG students**:
Franziska Schroeder (SARC) and Matthew Rodger (Psychology)

A4 **Address, tel. and email for correspondence**:

A5 **Proposed Start date**: 01/11/2011 A6 **Duration of project**: 3 Years

A7 **Where will the research be undertaken**?
The research will take place on the premises of Queens University, Belfast. More specifically, at the School of Music

A8 **List roles of individuals undertaking this research**:

Name	Role	Qualifications
Lilian Lima Simones	PhD student	Masters in Music Psychology in Education; undergraduate degree in Music.

Declaration
I have read the relevant Code of Conduct and will conduct this research in accordance with the Principles for Ethical Research and to the highest ethical standards

Signature Researcher(s): *Date*
(sign after printing)

Signature Supervisor: *Date:*

Research project

(A complete research protocol should be attached to this application. See Guidance notes on end page)

B1 **What is your research question(s)?**:

Over the course of the three-year PhD, this research will investigate the role of perception of movement/gesture in a teaching/learning context, taking into account different levels of musical skill and different teaching strategies. The research is to be carried out in the context of Western classical music, specifically focusing on piano teaching and learning.

Given the project is at an early stage, an exploratory investigation of teaching strategies and perception of gesture in a teaching/learning context is required to determine:

- teaching strategies
- the use of implicit and/or explicit body movements and gestures during the teaching process
- the outcomes for learning of such pedagogical strategies

This ethics application relates to an initial exploration of the research context. However, it is assumed that other related and more specific questions will arise during further development of the research, and a redefinition of more specific data-collection procedures might be required. The researcher will submit further applications to the Ethics Committee whenever changes are to be made.

B2 **Outline, briefly, the background to the research**:

The one-to-one pedagogical studio environment of instrumental music tuition in Western art music is grounded in musicians' general belief that this model is the most effective for teaching and learning artistic values and conventional performance practices. However, this teaching/learning context is far from uniform: many teachers, some of whom are respected performers, have no teaching diploma and no experience of music lessons other than the lessons they themselves received as students, and teachers trained as musicians generally do not have a specific knowledge of the biomechanics of musical performance. This alongside the high rates of physical injuries among students and musicians as a result of long hours of practice suggests that approaches to teaching may be based on subjective and vague perceptions of what works in the personal experience of the teacher, rather than on an accurate understanding of the principles of human movement.

These problems appear to be the result of several interacting factors: firstly, the frequently isolated environment of one-to-one tuition leaves little scope for structured discussion among teachers about their teaching process; secondly, there seems to be a trend towards a traditional style of teaching/learning that appears to rely strongly on teachers' personal approaches and preferences leading to an uninformed pedagogy; thirdly, that little research attention has been given to instrumental music teaching, to the "physicality" involved in learning to play a musical instrument alongside the essential role of the teacher in the development of this embodied skill, has certainly helped in maintaining the present status quo.

This research, apart from contributing empirical data regarding the role of movement in a teaching/learning context, aims in addition to initiate a debate among professionals on matters related to instrumental music tuition.

B3 **Outline, briefly, the methods and analysis you intend to use**:

The design frame chosen is a case study with a mixed method approach, in which I will be analysing qualitative and quantitative data from relevant participants involved in piano tuition (piano teachers and students). The data will be gathered through video recordings and questionnaires. The sampling method, in selecting the participants, will be purposive. The analysis will be based on video analysis, assessment of quantitative and qualitative data, with triangulation of information whenever possible.

B4a **Does this study involve any deception or with-holding information?**
If yes, why is this necessary? how does this conform to the Code of Conduct
Principles for Deception (Section 4 page 9 Revised Code of Conduct)?

It is crucial to the study that data collection is carried out in typical day-to-day pedagogical interaction. For this reason, it is assumed that explicitly informing participants about the focus of this study on the role of movement in a teaching/learning context could change the lesson dynamics. The researcher, therefore, will withhold information about the focus of the project on the role of movement during instrumental tuition, and allow the participants to focus on teaching/learning strategies in their instrumental music tuition.
After the video recording procedures are completed, the participants will be informed about the focus on the role of movement and specific findings of the project.

B4b **Does this study involve any physical risk to participants**?
If yes, why is this necessary? how has this been minimised?
None.

B4c **Does this study involve any psychological risk (e.g. cause upset, worry, stress, fatigue, feelings of being demeaned**?
If yes, why is this necessary? how has this been minimised?
The information given by participants will relate to their experience of teaching and learning to play a musical instrument. This information can be of a sensitive nature for the participant, depending on their personal experiences. Participants will be informed of their right to provide only information that they wish to give and of their right to be able to withdraw from the study prior to any publication of findings.

B4d **Does this study involve any social risk (e.g. loss of status, privacy, reputation)**?
If yes, why is this necessary? how has this been minimised?
All information given by participants will be presented anonymously. In cases where information could potentially identify the participants (i.e. video recordings), information will only be used where explicit and informed written permission is granted by the participant/s in question. In such cases, participants will be informed about who specifically will have access to this information.

B4e **Does this study require participants to disclose information of a sensitive or personal nature**?
If yes, why is this necessary? how has the procedure been adapted to minimise any feeling of distress at providing this information?
The information given by participants will relate to their experience of teaching and learning to play a musical instrument. This information can be of a sensitive nature for the participant, depending on their personal experiences. Participants will be informed of their right to provide only information that they wish to give and of their right to be able to withdraw from the study prior to any publication of findings.

B4f **Are there any other risks different from those encountered in everyday life**
If yes, why are they necessary, how is their potential effect minimised?
No.

B5 **How will confidentiality of participants and their responses are assured**?
Questionnaires will be anonymous and any identifiable data, such as video recordings of lessons will be held in a password protected computer and accessible ONLY to the researcher and her supervisors. Written permission will be sought from participants prior to any use of video material for educational or dissemination purposes. Pseudonyms will be assigned to all students and tutors.

B6 **If observational research is to be undertaken without prior consent, describe the situation and how privacy and individual confidentiality will be preserved**.
No observational research will take part without prior consent.

B7 **How will participants be debriefed**?
If no debriefing is planned say why not.
The participants will be approached by the researcher personally. Information about the study will be given verbally and in writing.

B8 **Is permission required from any other source before commencing the research, e.g. from School, Hospital**
If yes, state from where and what has/is been done to obtained this. Relevant permissions should be included – checklist 9
N/A

Participant Information

C1 **What participants will be used in the study**
Students at QUB (c. 30)
Piano teachers at QUB (c.5) and outside QUB (c. 5)
Piano students 15-years-of-age and under (c. 20) (researcher has recently undergone an Enhanced CRB Check at QUB)

C2 **How many will be used**?
Give numbers in each group, including any controls. How will participants be included or excluded – give criteria.
(Please refer to answer to question C1)

C3 **How will participants be recruited (e.g. e-mail, personal contact, posters, etc.)**?
Include a copy of any advert to be used to recruit participants (checklist 9)
Participants will be recruited by the researcher, personally.

C4 **What, if any, is the relationship between investigators and participants (e.g. fellow students, club members, family, friends, etc)**?
In case of any relationship between investigators and participants, the researcher will at all times acquire permission for the use of any information previously known by the researcher about the participants.

C5 **What information will be given to participants**?

Include copies of written information (Participant Information Sheet). If information is provided verbally say what is provided and why this is done verbally?

The following information is to be provided verbally and in written form: the nature and purpose of the study, including its methods, expected benefits; information about confidentiality, anonymity and how the data will be kept; the option for a potential participant to choose to take part or not; and the researcher's name and contact details. See attached document for participants' information and consent forms.

C6 **How will participants give consent**?

It is expected consent will be written, if not why not? Include a copies of the consent form

Participants will give informed written consent, except for the questionnaires, where no signed consent will be recorded, in order to protect participants' right to confidentiality.

C7 **If individuals are unable to give consent, e.g. through age or incapacity, how will consent be obtained**?

For cases where participants are under 16 years old, informed written consent from the parent or guardian is required. In cases where a parent or guardian's consent is given, participants will be given age-appropriate information about the study and asked about their willingness to take part in the study. Participation will only take place if the child shows willingness to participate, independently of parental or guardian's consent.

C8 **Are there any medical conditions which increase participants' risk when undertaking the study**?

If yes, how will this information be obtained?

None that I am aware of.

C9 **Can participants withdraw from the research at any time**

How and when are participants informed of this?

Participants can withdraw from participating in the research at any time. However, they will only be able to withdraw their data from the research, prior to research publications. This information will be provided to prospective participants when invited to participate in the study.

C10 **What will happen if participants wish to withdraw**?

Participants will be informed that if they wish to withdraw they can freely do so. They will be required to sign a participant withdrawal form, stating ONLY that they wish to withdraw, the date and their signature.

If withdrawal happens before any publication of findings, the participant's specific data will be destroyed (except for the withdrawal form) and taken into account in the research findings.

If any publication occurs before the participant's withdrawal, the participant will be informed verbally and in written form that, unfortunately it will not be possible to withdraw their data from the findings and publications at that late stage.

C11a **Will confidentiality of information be preserved**?

Confidentiality of information will be preserved at all times.

C11b **What steps will be taken to ensure this**?

Questionnaires will be anonymous and any identifiable data such video recordings of lessons will be held in a password protected computer and accessible ONLY to the researcher and her supervisors. Pseudonyms will be assigned to all students and piano teachers.

C11c **Where will data be stored**?
Questionnaires, audio and video recordings will be stored in a locked cabinet. Digital information on the researcher's PC will be locked with the use of a password ONLY known by the researcher. The mentioned data will be destroyed ten years after data treatment. An exception to this might be relevant video recordings, in which case, permission not to destroy this material will be sought from the participants.

C11d **Who will have access to this data**?
The researcher and her supervisors.

C11e **Where will consent forms be stored**?
In a locked cabinet at SARC's office.

C11f **Will individually identifiable information be given to third parties or available through publications, etc.**
If yes, state why this is necessary and demonstrate participants are aware of this.
No identifiable information will be given to third parties without participants' explicit written consent. Should a situation arise where the researcher considers that disclosing individually identifiable information would benefit empirical knowledge, the participant in question will be consulted and given information about the exact material under consideration. The participant will be informed of third parties' exact involvement. Only upon the participant's informed written consent, will the researcher proceed with the matter.

C12 **Is any payment provided to participants**?
If yes, how much? what for? and why is this necessary?
None

Appendix D

Participants' information and consent forms used for the investigations reported in Chapters 3 and 4

Lilian Simones (lsimones01@qub.ac.uk)

Dear Student,

My name is Lilian Simones and I am currently a student at Queen's University, Belfast, involved in a PhD research project concerning the outcomes of teaching strategies in learning to play the piano. The project aims to identify effective teaching strategies, with a view to contributing to informed teaching practice.

I am writing in the hope that you might, very kindly, be willing to participate in this research, in the following ways:

- To take part in a questionnaire.
- Allow video recordings of three of your piano lessons with your piano teacher, at your usual time and place.

The purpose of the questionnaire and video recording is to ask about your experience of performance tuition, both prior to and at university. The video recordings will take place at the university and the data will be analysed by myself. You and your piano teacher will be able to view the video recordings, if you wish to do so. The questionnaire and video recordings will be treated in the strictest confidence, kept in a secure place at Queen's University, Belfast, accessible only to the researcher and her supervisors, and will be destroyed ten years after data analysis is completed.

I hope that you will be happy to participate in this research and would be glad to answer any questions you may have. If you wish to contact me please use the email address above.

With many thanks,
Lilian Simones

✂---

Project: 'The outcomes of teaching strategies in learning to play the piano'

I ______________________________ agree to participate in a questionnaire and video recordings for the above project. I am aware that the resulting records will be kept securely and confidentially, that they will be accessible only to the researcher and her supervisors, that I and my teacher will not be identifiable in any way or named in these records or in any reports or other publications resulting from this research, and that I am free to withdraw at any time prior to any publications arising from this research. I consent to video-recorded material being used in educational presentations such as conferences.

Date:
Please provide a contact for further communication:

Lilian Simones (lsimones01@qub.ac.uk)

Dear Piano teacher,

My name is Lilian Simones and I am a student at Queen's University, Belfast, currently involved in a PhD research project concerning the outcomes of teaching strategies in learning to play the piano. The project aims to identify effective teaching strategies, with a view to contributing to informed teaching practice. I am writing in the hope that you might, very kindly, be willing to participate in this research, in the following ways:

- To fill out a questionnaire
- To allow video recordings of three of your piano lessons with your piano students, at your usual time and place.

The purpose of the questionnaire is to ask about your experience of piano tuition. The video recordings will take place at the university and while you are teaching a predefined musical repertoire to your own students. The data will be analysed by myself. You will not be named in any publications resulting from this research. You and your student will be able to view the videos, if you wish to do so. The questionnaire and video recordings will be treated in the strictest confidence, kept in a secure place, accessible only to the researcher and her supervisors, and will be destroyed ten years after data analysis is completed.

I hope that you will be happy to participate in this research and would be glad to answer any questions you may have. If you wish to contact me please use the email address above.

With many thanks,

Lilian Simones

✂--

Project: 'The outcomes of teaching strategies in learning to play the piano'

I ____________________________________ agree to fill out a questionnaire and take part in video recordings for the above project. I am aware that the resulting records will be kept securely and confidentially, that they will only be accessible to the researcher and her supervisors, that I and my student will not be identifiable in any way or named in these records or any reports or other publications resulting from this research, and that I am free to withdraw at any time prior to any publications arising from this research. I consent to video-recorded material being used in educational presentations such as conferences.

Date:
Please provide a contact for further communication:

Lilian Simones (lsimones01@qub.ac.uk)
Phone: xxxxxxxx

Dear Parent/Guardian

I am a student at Queen's University, Belfast, and I am currently involved in a doctoral research project concerning teaching strategies in piano tuition. This research will help to identify teaching strategies and to understand how effective these can be in learning to play the piano. I am seeking your permission for your child to participate in this study as follows:

- To fill out a questionnaire.
- Allow video recordings of three of his/her piano lessons, at the usual time and place.

The questionnaire is to ask about your child's piano learning experience. The video recordings are to help analyse teaching strategies employed during the piano lessons. You and your child will be able to look at the videos if you wish to do so. Your child's piano teacher will also be able to view the videos on a separate occasion. The questionnaire and video recordings will be treated in the strictest confidence, kept in a secure place, only accessible by the researcher and her supervisors and will be destroyed ten years after data analysis is completed. Your child will not be named in any publications resulting from this research. Your child is under no obligation to take part in this study and will be free to withdraw at any point. In such an event, you will be able to withdraw the data provided by your child, as long as you do so prior to any publication of findings. I hope that your child will be happy to participate in this research and I would be glad to answer any questions you may have about your child's participation. If you wish to contact me please use the phone number or email above.

With many thanks,
Lilian Simones

✂---

Project: "The outcomes of teaching strategies in learning to play the piano"

I give permission for my child (insert name)____
to fill out a questionnaire and undergo video recordings of piano lessons for the above project. I am aware that the questionnaire and video recordings are confidential and that my child will not be named in these records or in any research publications. I am aware that these recordings will be kept securely and confidentially and that my child is free to withdraw at any time prior to any publications arising from this research. I also consent to video recorded material being used in educational presentations such as conferences.

Signed: ______________________________ Date: _________________________

Please provide a contact for further communication: _________________________________

Appendix E

Ethics application for the investigation reported in Chapter 6

School of Creative Arts
Queen's University of Belfast

Research Ethics Application

You must complete the form in full and in typescript. Please look to the guidance notes and undergraduate notes when completing this form. Failure to fully complete the form may delay the process of considering your application. Not all questions may be relevant, if they are not answer with N/A. Do NOT leave questions blank.

The following documents are required to consider your application. Please tick each checkbox to indicate this information has been included.

1)	Completed Research Ethics Application form (this form)	X	For undergraduate applicants submit 2 copies of each. All other applicants submit 5 copies.
2)	Participant Information sheet (footnote 1)	X	
3)	Participant Consent form (footnote 2)	X	
4)	Research protocol (footnote 3)	X	

6) Any other information to support the application (1 copy) ☐
List details

Is this project (tick as appropriate)

Undergraduate research	☐	MSc research	☐	MA research	☐
BMus. Research	☐	BSc research	☐	PhD research	X

Undergraduates please submit this form, when complete, to your supervisor.

Your research may not begin until you have received notification from the School of Creative Arts Research Ethics Committee, or your supervisor.

Research project

(A complete research protocol should be attached to this application. See Guidance notes on end page)

B1 **What is your research question(s)?**:

1) Do teachers' Mimics gestures help students learning to perform staccato more efficiently overtime? And if so, does this happen simply by observing teacher Mimics gestural production or by observation alongside student performance of teachers' gestures by imitation?
2) Are there differences in relation to student learning outcomes overtime, regarding staccato playing, in relation to skill level and Mimics observation versus observation alongside student performance of teacher mimics gesture?

B2 **Outline, briefly, the background to the research**:

The study of body movements and gesture in music has enjoyed a growing level of interest from the field of music performance in the context of the Western classical musical tradition during the last twenty years, with remarkable advances being made in areas such as solo performance, ensemble performance and gestures used by orchestra/choir conductors, mostly with expert music performers. However, little consideration has been given to the impact that teaching/learning contexts can have on resulting musical performance in different contexts, and how body movements and gestures essential for performance are developed during the process of skill acquisition, not to mention aspects such as the "physicality" involved in teaching and learning to play a musical instrument, or the essential role of the teacher in the development of this embodied skill – almost a missing chapter in music research literature. The PhD thesis (in progress) from which this study is part of, seeks to address such under investigated topics, aiming to understand the role of body gestures in teacher and student communicative interaction during piano lessons, specifically in the process of communicating symbolic and functional musical knowledge and its implications for the learning process.

The results of an initial exploratory study into the role of gesture in instrumental music teaching and learning (Simones, Schroeder & Rodgers, 2013) revealed that there are spontaneous co-musical gestures in the context of instrumental music teaching comparable to spontaneous bodily gestures accompanying and/or supplementing speech (McNeill, 1992; 2005), that music gestural classifications from the field of music performance are not suitable

for classifying. The authors (the present researchers), beside proposing a categorisation of piano teachers' gestures that enables systematic research to be carried on this topic in this context, found a correlation between teaching behaviours (adopted and adapted from Carlin, 1997 and Zhukov, 2004) and gesture types, suggesting that there is a relationship between the didactic intention of the teacher and the forms of gesture they use to communicate information to the student (Simones et al., 2013). Such findings suggest that the nature and effectiveness of this relationship (in terms of student learning outcomes of teachers' gestures) should be the subject of investigation, particularly comparisons of teachers teaching different levels of student proficiency. In addition, findings from a second study by the same authors revealed differences in terms of gesture frequencies in relation to student skill-level suggesting that teachers adapted gestural communicative channels to suit students' perceived conceptual levels, while developing interpretative meaning construction with each of the student levels in study (elementary and level 1 piano students). 'Mimics' and 'Touch' were used more frequently for students of Elementary Level, whilst 'Metaphoric' and 'Iconic' gestures were used in comparatively more instances with Level 1 than Elementary. Teachers appeared sensitive to the importance of learning through hands-on experience as suggested by Piaget (1936) and Vygotsky

(1986), and relied greatly on imitational processes in association with 'Mimics' and 'Touch' gestures for a scaffolding approach that consisted of building on the knowledge gained through action and introducing new knowledge gradually. However, it remains to be ascribed if teachers teaching gestural scaffolding approaches have or not a role in terms of student learning effectiveness.

B3 **Outline, briefly, the methods and analysis you intend to use**:

This study is of an experimental nature, designed to provide answers to the previously mentioned (see B1) research questions.
The procedure is here described in three steps: a) prior to the experiment, b) experiment and c) after the experiment.

a) Prior to the experiment:

- SARC ethical approval and informed formal consent from participants will be sought.
- After consent is given individuals will be selected for taking part on the experiment: only individuals that do not perform the same style/type of staccato playing as intended to be taught during the experiment, will be selected for the experiment.
- The Participants selected to take part on the experiment will be given information about the study and instructed not to talk to the teacher or ask questions during the procedure and to purely follow teacher instructions.
- Teacher training: The teacher will memorise a prepared monologue with almost equal verbal text for all the three groups in the experiment. What will change in teacher approach to the three groups will be the addition of Mimics gesture and specific request for student imitation. Special care is given in the writing of the script and teacher training to ensure that eye gaze, voice intonation and other factors are similar as possible across conditions with special attention paid to the fact that lots of things have a tendency to vary along with gesture and we do not want to introduce any confounds.

b) Experiment:

The students' population will be divided into three groups (group I, group II and group II. The task for all groups is to play a scale, using only white keys and second finger of right hand, performing staccato for each note). While attempting to do so, each of the groups will be submitted to a specific teaching/learning condition, as follows:

- Group I: teacher does not produce Mimics gesture, or any sort of demonstration: Teacher provides verbal explanations of how to perform a given musical extract and student is presented with an audio recording of the material (to be listened 5 consecutive times). Student is then requested to play it on the piano, 5 times.
- Group II: Teacher provides verbal explanations of how to perform a given musical extract, followed by teacher performing the scale, in staccato (life) for the student, 5 consecutive times. Student is requested to play the scale afterwards, also 5 times.

- Group III: Teacher gives verbal explanations of how to perform a given musical extract, followed by teacher performing the musical piece for the student (5 times). However, after each time teacher performed the scale, the student is asked to play the scale, imitating teacher's actions, for 5 times, intercalating with teacher's demonstrations.

Each experimental session will be video recorded and only sessions in which teacher performed the experiment as planned, that is in which no confound variables were introduced will be accepted for analysis.

c) After the experiment

- Students' post-tests will be carried out as follows: immediately, 12 hours and a week after the experiment. All the post-tests will be video recorded. The post-tests are intended to serve two purposes 1) evaluation of students' learning retention of the required task and 2) students' capacity of transfer the learned knowledge to a similar, but newer task. As such, each post-test will consist of two parts, first student will perform the material taught on the experiment in addition to a new given task (different for each test).
- The evaluation of the post-tests will be twofold: 1) sonogram analysis (sound intensity and duration) against a pre-defined template of intended sound production quality and 2) video analysis, looking at wrist movement, trajectory and amplitude of movement, also against a pre-defined template of movement quality required for executing the intended type of staccato.

Statistical analysis will be carried out on the results of post-tests in relation to student skill levels and experimental condition they have been submitted to.

B4a **Does this study involve any deception or with-holding information?**
If yes, why is this necessary? how does this conform to the Code of Conduct Principles for Deception (Section 4 page 9 Revised Code of Conduct)?

It is assumed that explicitly informing participants about the specific focus of this study to be on Mimics gesture could change the way participants react to the experiment, with serious implications in the results. The researcher, therefore, will withhold information about the focus on Mimics gesture and inform participants that the study is focused on teaching/learning strategies in piano tuition.

B4b **Does this study involve any physical risk to participants**?
If yes, why is this necessary? how has this been minimised?
None.

B4c **Does this study involve any psychological risk (e.g. cause upset, worry, stress, fatigue, feelings of being demeaned**?
If yes, why is this necessary? how has this been minimised?
None.

B4d **Does this study involve any social risk (e.g. loss of status, privacy, reputation)**?
If yes, why is this necessary? how has this been minimised?
All information given by participants will be presented anonymously. In cases where information could potentially identify the participants (i.e. video recordings), it will only be used where explicit and informed written permission is granted by the participant/s. In such cases, participants will be informed about who specifically will have access to this information.

B4e **Does this study require participants to disclose information of a sensitive or personal nature**?
If yes, why is this necessary? how has the procedure been adapted to minimise any feeling of distress at providing this information?
None.

B4f **Are there any other risks different from those encountered in everyday life**
If yes, why are they necessary, how is their potential effect minimised?
No.

B5 **How will confidentiality of participants and their responses are assured**?
The Video recordings of the experiment will be held in a password protected computer and only accessible to the researcher and her supervisors. Written permission will be sought from participants prior to any use of video material for educational or dissemination purposes. Pseudonyms will be assigned to all students and teacher taking part in the experiment.

B6 **If observational research is to be undertaken without prior consent, describe the situation and how privacy and individual confidentiality will be preserved**.
No observational research will take part without prior consent.

B7 **How will participants be debriefed**?
If no debriefing is planned say why not.
The participants will be approached by the researcher personally. Information about the study will be given verbally and in writing.

B8 **Is permission required from any other source before commencing the research, e.g. from School, Hospital**
If yes, state from where and what has/is been done to obtained this. Relevant permissions should be included – checklist 9
N/A

Participant Information

C1 **What participants will be used in the study**
60 piano students of various ages and skill levels and 1 piano teacher (the researcher).

C2 **How many will be used**?
Give numbers in each group, including any controls. How will participants be included or excluded – give criteria.
(Please refer to answer to question C1)

C3 **How will participants be recruited (e.g. e-mail, personal contact, posters, etc.)**?
Include a copy of any advert to be used to recruit participants (checklist 9)
Participants will be recruited by the researcher, personally.

C4 **What, if any, is the relationship between investigators and participants (e.g. fellow students, club members, family, friends, etc)**?
In case of any relationship between investigators and participants, the researcher will at all times acquire permission for the use of any information previously known by the researcher about the participants.

C5 **What information will be given to participants**?
Include copies of written information (Participant Information Sheet). If information is provided verbally say what is provided and why this is done verbally?
The following information is to be provided verbally and in written form: the nature and purpose of the study, including its methods, expected benefits; information about confidentiality, anonymity and how the data will be kept; the option for a potential participant to choose to

take part or not; and the researcher's name and contact details. (See attached document for participants' information and consent forms).

C6 **How will participants give consent**?
It is expected consent will be written, if not why not? Include a copies of the consent form
Participants will give informed written consent.

C7 **If individuals are unable to give consent, e.g. through age or incapacity, how will consent be obtained**?
For cases where participants are under 15 years old, informed written consent from the parent or guardian is required. In cases where a parent or guardian's consent is given, participants will be given age-appropriate information about the study and asked about their willingness to take part in the study. Participation will only take place if the child shows willingness to participate, independently of parental or guardian's consent.

C8 **Are there any medical conditions which increase participants' risk when undertaking the study**?
If yes, how will this information be obtained?
None that I am aware of.

C9 **Can participants withdraw from the research at any time**
How and when are participants informed of this?
Participants can withdraw from participating in the research at any time. However, they will only be able to withdraw their data from the research, prior to research publications. This information will be provided to prospective participants when invited to participate in the study.

C10 **What will happen if participants wish to withdraw**?
Participants will be informed that if they wish to withdraw they can freely do so. They will be required to sign a participant withdrawal form, stating ONLY that they wish to withdraw, the date and their signature.
If withdrawal happens before any publication of findings, the participant's specific data will be destroyed (except for the withdrawal form) and taken into account in the research findings.
If any publication occurs before the participant's withdrawal, the participant will be informed verbally and in written form that, unfortunately it will not be possible to withdraw their data from the findings and publications at that late stage.

C11a **Will confidentiality of information be preserved**?
Confidentiality of information will be preserved at all times.

C11b **What steps will be taken to ensure this**?
Identifiable data such as video recordings of lessons will be held in a locked cabinet and accessible ONLY to the researcher and her supervisors. Pseudonyms will be assigned to all students and piano teacher.

C11c **Where will data be stored**?
Video recordings will be stored in a locked cabinet. Digital information on the researcher's PC will be locked with the use of a password ONLY known by the researcher. The mentioned data will be destroyed ten years after data treatment. An exception to this might be relevant video recordings, in which case, permission not to destroy this material will be sought from the participants.

C11d **Who will have access to this data**?
The researcher and her supervisors. Videos will be shown in conferences and for educational purposes in cases where participants have given permission.

C11e **Where will consent forms be stored**?
In a locked cabinet at SARC's office.

C11f **Will individually identifiable information be given to third parties or available through publications, etc.**
If yes, state why this is necessary and demonstrate participants are aware of this.

No identifiable information will be given to third parties without participants' explicit written consent. Should a situation arise where the researcher considers that disclosing individually identifiable information would benefit empirical knowledge, the participant in question will be consulted and given information about the exact material under consideration. The participant will be informed of third parties' exact involvement. Only upon the participant's informed written consent, will the researcher proceed with the matter.

C12 **Is any payment provided to participants**?
If yes, how much? what for? and why is this necessary?
None

Administration of Questionnaires to Participants

D1 Will you be administering any questionnaires to participants
No.

D2 If yes to D1 list the questionnaires you will be using below. For each questionnaire state: a) title, b) reference, if published, or if unpublished provide copies of the questionnaire with the application, c) purpose of the questionnaire.

Appendix F

Participants' information and consent forms used for the investigation reported in Chapter 6

Lilian Simones (lsimones01@qub.ac.uk)
Phone: xxxxxxxx

Dear Student,

My name is Lilian Simones and I am currently a student at Queen's University, Belfast, involved in a PhD research project concerning the outcomes of teaching strategies in learning to play the piano. The project aims to identify effective teaching strategies, with a view to contributing to informed teaching practice. I am writing in the hope that you might, very kindly, be willing to participate in this research, in the following ways:

- To take part in a short piano lesson.
- To play the musical material learnt during that piano lesson and a similar given piece in three different occasions: immediately after the lesson; 12 hours after the lesson; and one week after the lesson.
- To allow video recordings of the piano lesson and of the three performances of the musical material.

The piano lesson and performances will be carried out at Queen's University (SARC or School of Music). Prior to the experiment you will be met by a piano teacher to assess your suitability for the experiment. During the experiment you will be required not to talk and simply to follow the instructions given by the piano teacher. It is anticipated that the lesson will take no longer than 5 minutes and each the performances no longer than 3 minutes. You will not be named in any publications resulting from this research. The video recordings will be treated in the strictest confidence, kept in a secure place at Queen's University, Belfast, destroyed ten years after data analysis is completed and will be viewed by the researcher and her supervisors. I hope that you will be happy to participate in this research and would be glad to answer any questions you may have. If you wish to contact me please use the email address above.

With many thanks,
Lilian Simones

✂---

Project: 'Learning outcomes of teaching strategies in learning to play the piano'
I ______________________________ agree to participate in this experiment and allow video recordings of the piano lessons and subsequent piano performances. I am aware that the resulting records will be kept securely and confidentially, that they will be accessible only to three piano teachers, the researcher and her supervisors, that I will not be identifiable in any way or named in these records or in any reports or other publications resulting from this research, and that I am free to withdraw at any time prior to any publications arising from this research. I consent to video-recorded material being used in educational presentations such as conferences.

Date: Please provide a contact for further communication:

Lilian Simones (lsimones01@qub.ac.uk)
Phone: xxxxxxx

Dear Parent/Guardian

I am a student at Queen's University, Belfast, currently involved in a doctoral research project concerning teaching strategies in piano tuition. This research will help to identify teaching strategies and to understand how effective these can be in learning to play the piano. I am seeking your permission for your child to participate in this study as follows:

- To take part in a short piano lesson.
- To play the musical material learnt during that piano lesson and a similar given piece in three different occasions: immediately after the lesson; 12 hours after the lesson; and one week after the lesson.
- To allow video recordings of the piano lesson and of the three performances of the musical material.

The piano lesson and performances will be carried out at Queen's University (SARC or School of Music). Prior to the experiment your child will be met by a piano teacher in order to assess your child's suitability for the experiment. The piano lesson is to be carried out by a CRB checked piano teacher, your child will be required not to talk and simply to follow the instructions given by the piano teacher, during the piano lesson. It is anticipated that the lesson will take no longer than 5 minutes and each the performances no longer than 3 minutes. Your child will not be named in any publications resulting from this research. The video recordings will be treated in the strictest confidence, not accessible from the Internet, kept in a secure place at Queen's University, Belfast, destroyed ten years after data analysis is completed and will be viewed by the researcher and her supervisors. Your child is under no obligation to take part in this study and will be free to withdraw at any point. In such an event, you will be able to withdraw the data provided by your child, as long as you do so prior to any publication of findings. I hope that your child will be happy to participate in this research and would be glad to answer any questions you may have about your child's participation. If you wish to contact me please use the phone number or email above.

With many thanks,
Lilian Simones

✂--

Project: "The outcomes of teaching strategies in learning to play the piano"

I give permission for my child (insert name) ______________________________

to participate in a piano lesson and video recordings for the above project. I am aware that my child will not be named in these records or in any research publications. I am aware that these recordings will be kept securely and confidentially and that my child is free to withdraw at any time prior to any publications arising from this research. I also consent to video recorded material being used in educational presentations such as conferences.

Signed: ______________________________ Date: ______________________

Please provide a contact for further communication: ______________________

Appendix G

Researcher's monologue for the experimental study reported in Chapter 6

Group I		**Group II**		**Group III**	
Text and gesture	**Eye gaze**	**Text and gesture**	**Eye Gaze**	**Text and gesture**	**Eye Gaze**
Hi, and thanks for taking part in this lesson	Student	Hi, and thanks for taking part in this lesson	Student	Hi, and thanks for taking part in this lesson	Student
Do you know what staccato is? If yes: can you please play some staccato notes on the piano for me? If no: Can you please play some short and energetic notes on the piano for me?	Student	Do you know what staccato is? If yes: can you please play some staccato notes on the piano for me? If no: Can you please play some short and energetic notes on the piano for me?	Student	Do you know what staccato is? If yes: can you please play some staccato notes on the piano for me? If no: Can you please play some short and energetic notes on the piano for me?	Student
Staccato is an Italian word that means that sound played in musical instruments should be short (pause), energetic (pause) and detached (pause)	Student	Staccato is an Italian word that means that sound played in musical instruments should be short (pause), energetic (pause) and detached (pause)	Student	Staccato is an Italian word that means that sound played in musical instruments should be short (pause), energetic (pause) and detached (pause)	Student
I will first ask you to listen five times to a recording of a staccato scale, and after I will ask you to play it for me five times also It starts on this C (deictic) and finishes on the next C, up here (deictic). After you listened I will ask you to play it on the piano five times, using only the second finger of your right hand.	Student Piano Student	I will play it for you five times, and after I will ask you to play if for me five times also. I will start on this C (deictic) and finish on The next C, up here (deictic) After you listened I will ask you to play it on the piano five times, using only the second finger of your right hand.	Student Piano Student	I will play it for you and ask you to imitate me. We will do this for five times. I will start on this C (deictic) and finish on The next C, up here (deictic) After you listened I will ask you to play it on the piano five times, each time after I played. using only the second finger of your right hand.	Student Piano Student
So listen	Student Sound device	So Watch me	Student Piano	So watch me	Student Piano
Now, please play the scale	Student	Now, please play the scale	Student	Now, please play the scale	Student

starting on this C (Diectic), and finishing on this Other C up here (Diectic), five times using only the second finger (Show finger) of your right hand.	Piano Student	starting on this C (Diectic), and finishing on this Other C up here (Diectic), five times using only the second finger (show finger) of your right hand.	Piano Student	starting on this C (Diectic), and finishing on this Other C up here (Diectic), using only the second finger (show finger) of your right hand.	Piano Student
Remmember to play staccato, which means that the sound should be short (pause), energetic (pause) and detached (pause).	Student	Remmember to play staccato, which means that the sound should be short (pause), energetic (pause) and detached (pause).	Student	Remmember to play staccato, which means that the sound should be short (pause), energetic (pause) and detached (pause).	Student
1) (When student plays) When student stops: Again please 2) (repeat) 3) (repeat) 4) (repeat) 5) (repeat)	Piano Student Piano Student Piano Student Piano Student Piano Student	1) (When student plays) When student stops: Again please 2) (Repeat) 3) (repeat) 4) (repeat) 5) (repeat)	Piano Student Piano Student Piano Student Piano Student Piano Student Piano Student	1) (when student plays) When student stops, teacher says: I will play it for you so that you can watch and imitate me. 2) Teacher plays After playing says to student please play again and imitate me (this will be done for a total of five times 3) Repeat 4) Repeat 5) repeat	piano Student Piano Student Piano Student Piano Student Piano Student
Thank you!	Student	Thank you!	Student	Thank you!	Student